

C5935  
1.986  
Copy 3

# CLEMSON UNIVERSITY



## ANNUAL REPORT

1985-1986

S. C. STATE LIBRARY

JAN 21 1987

*State*  
~~Federal~~ Depository Document

Printed Under The Direction Of The  
State Budget And Control Board



## CLEMSON UNIVERSITY

PRESIDENT

A year of transition and new administration initiatives for advancing the University as a national center for teaching and research excellence characterized Clemson's 1985-86 year.

It was a year which saw record fund raising from the private sector, including the largest individual gift in Clemson history, preparations for a grand celebration of the University's Centennial, and the unveiling of a blueprint for the school's next 100 years of service -- "Clemson University: The Second Century."

And it was a very special year for me personally.

The opportunity to become the president of this fine University was extended to me, and I officially was named to that office on October 14, 1985. I began my service as eleventh president in March 1986.

The Second Century plan targets five major research areas to receive Clemson's greatest emphasis in the immediate future: 1) agriculture, 2) engineering and basic science, 3) marketing and management, 4) quality of life, and 5) textiles.

The plan emerged from the combined efforts of the administration, faculty and deans who put the program together. It received the full endorsement of the Board of Trustees and that of a prestigious 30-member President's Advisory Council of corporate and public leaders.

The general priorities and the five emphasis areas set forth in the Second Century plan are those that are essential if the University is to have a positive impact on economic progress in the state and region.

I am extremely proud of the Clemson student body. Our students are enthusiastic and serious-minded about getting the best academic preparation possible for careers in today's world.

Our entering freshmen continue to have a high average on their SAT scores. For the first semester 1986-87 school year, 2,239 entering freshmen had an average SAT score of 1,025 -- some 210 points above the state average for high school seniors in 1985. Overall enrollment in the fall 1985 semester was 12,893. Graduate enrollment increased slightly during this period.

There was a major development to report on the brick-and-mortar front during the year. Groundbreaking ceremonies for the Thurmond Institute building were held Nov. 8, 1985. Vice President George Bush and Sen. Strom Thurmond were among the dignitaries on hand to turn the first shovels. The \$5.5-million building will be headquarters for scholarship, research and public service programs related to government and public affairs.

And Clemson's bid for a multipurpose livestock arena won approval from the General Assembly. The planned \$4.4-million complex will be used for educational programs, horse and livestock shows, sales, 4-H activities, industrial and agricultural expositions, and other public activities.



Private support for Clemson academics reached an all-time high, including a \$1.05-million gift of stocks to the Clemson University Foundation from alumnus Bob Campbell of Gaffney and his wife, Betsy. The gift will endow the Bob Campbell Chair of Technical Communications, which will be a joint appointment in the colleges of liberal arts and engineering.

The chair is the first of its kind in the nation and positions Clemson as a national leader in shaping the emerging field of technical communications.

All told, private giving for academics hit a record \$6.8 million in the 12 months of the 1985-86 fiscal year. This was \$1.3 million more than the total amount given during the previous 18-month transition period when academic fund-raising programs were switching from a calendar-year accounting system to a fiscal-year system.

Overall enrollment (12,893) declined slightly in the fall 1985 semester, while graduate enrollment increased slightly.

These are only a few highlights of a busy and productive year at Clemson University. More details on the year's activities are presented in the body of this report.

A handwritten signature in dark ink, appearing to read 'Max Lennon', with a long, sweeping horizontal line extending to the right.

Max Lennon  
President

# TABLE OF CONTENTS

	Page
University Board of Trustees.....	4
University Administration.....	5
Academics.....	6
Colleges	
Agricultural Sciences.....	7
Architecture.....	9
Commerce and Industry.....	13
Education.....	20
Engineering.....	23
Forest and Recreation Resources.....	34
Liberal Arts.....	37
Nursing.....	41
Sciences.....	44
Graduate School.....	53
Undergraduate Studies.....	53
Administration.....	54
Office of University Research.....	56
The Strom Thurmond Institute.....	56
Clemson University Libraries.....	57
Computing Services.....	60
Office of Human Resources.....	64
Institutional Advancement.....	65
Students.....	69
Operating Funds.....	78
Public Service Programs of the	
College of Agricultural Sciences.....	80
South Carolina Agricultural Experiment Station.....	80
Cooperative Extension Service.....	105
Division of Regulatory and Public Service Programs.....	123
Livestock-Poultry Health Division.....	129

UNIVERSITY BOARD OF TRUSTEES

Louis P. Batson, Jr.  
Chairman of the Board

Life Trustees

Robert R. Coker,  
Hartsville

William Green DesChamps, Jr.,  
Bishopville

Paul W. McAlister,  
Laurens

Thomas B. McTeer, Jr.,  
Columbia

Buck Mickel,  
Greenville

James C. Self,  
Greenwood

James M. Waddell, Jr.,  
Beaufort

Elected Trustees  
(Four-Year Terms)

Billy L. Amick,  
Batesburg

Louis P. Batson,  
Greenville

B. Marion Smith,  
Sumter

John J. Britton,  
Sumter

Fletcher C. Derrick, Jr.,  
Charleston

William N. Geiger, Jr.,  
Columbia



## UNIVERSITY ADMINISTRATION

- <sup>1</sup> Max Lennon, President
- <sup>2</sup> W. David Maxwell, Provost and Vice President for Academic Affairs;  
Acting Vice President for Business and Finance
- <sup>3</sup> J. Donald Elam, Vice President for Institutional Advancement
- <sup>4</sup> Manning N. Lomax, Acting Vice President for Student Affairs  
  
Hugh J. Clausen, Vice President for Administration, Secretary of the  
Board of Trustees
- <sup>5</sup> Benton H. Box, Vice President/Vice Provost for Agriculture and  
Natural Resources.  
  
Benjamin W. Anderson, University Legal Counsel  
  
Wade A. Green, Assistant to the President for Public Affairs  
  
Frank Mauldin, Assistant to the President and Director of the Office of  
Human Resources

---

<sup>1</sup> Succeeded Walter T. Cox as President March 3, 1986.

<sup>2</sup> Assumed Acting position on October 9, 1985, after Melvin E. barnette, former Vice President for Business and Finance, left the University. David Larson assumed this position July 1, 1986.

<sup>3</sup> Walter T. Cox assumed Acting position July 11, 1986.

<sup>4</sup> Assumed Acting position July 1, 1985.

<sup>5</sup> Assumed Acting duties of this newly created position July 1, 1986.

ACADEMICS 1985-1986

Graduate School  
Arnold E. Schwartz, Vice Provost and Dean

Undergraduate Studies  
Jerome V. Reel, Vice Provost

College of Agricultural Sciences  
<sup>1</sup>Luther P. Anderson, Dean

College of Architecture  
<sup>2</sup>Lamar Brown, Acting Dean

College of Commerce and Industry  
Ryan C. Amacher, Dean

College of Education  
James E. Matthews, Dean

College of Engineering  
J. Charles Jennett, Dean

College of Forest and Recreation Resources  
Benton H. Box, Dean

College of Liberal Arts  
Robert A. Waller, Dean

College of Nursing  
Mary Lohr, Dean

College of Sciences  
Henry E. Vogel, Dean

---

<sup>1</sup> Stephen R. Chapman assumed Acting position July 1, 1986.  
<sup>2</sup> James F. Barker assumed position as Dean July 21, 1986.

## COLLEGE OF AGRICULTURAL SCIENCES

### Agricultural Instruction

Instructional programs in agriculture at Clemson University continue to be guided by the philosophy and mandate of the will of Thomas Green Clemson, "to afford thorough instruction in agriculture and the natural sciences connected therewith." Agriculture is an increasingly complex professional field of significant economic importance to South Carolina. Instructional programs must constantly be evaluated to help ensure that graduates are versed in the problem-solving skills, as well as business and communications skills needed to serve this complex industry.

Agriculture remains the leading force in alleviating the tragic losses of human life and productivity associated with persistent, widespread undernourishment and malnutrition. The traditional roles of providing food and fiber for humans and feed for domestic animals, while protecting vital natural resources and enhancing the environment, will be of increasing general importance. Agriculture remains the major positive element of our nation's balance of payments as well as a major employer, accounting for about 20 percent of the nation's jobs. Clearly, agriculture involves far more than crop and livestock production.

In South Carolina, agriculture is an industry worth more than \$2 billion. This productivity is about equally divided between production (farming) and processing and packaging. About 66 percent of the farm income is derived from crops. The production of ornamentals and turf is an area of growing economic significance, and aquaculture is a potentially strong growth area. Regardless of the specific area, agriculture must be recognized as a big business, high technology, professional field. To serve agriculture effectively, graduates must not only be competent in basic sciences and modern technology, but also in business and communication skills, including the use of computers.

To satisfy the basic undergraduate instructional mission, the College of Agricultural Sciences offers a spectrum of curricula related to nearly all phases of agriculture, stressing the application of academic principles to recognition and resolution of real problems. Caution must be exercised to avoid over emphasis on teaching solutions, rather than developing problem-solving abilities. Curricula must be evaluated to ensure that the most current information and concepts are presented to students. The association of teaching and research in the College of Agricultural Sciences reflects the basic structure and philosophy of the land-grant institution and helps ensure that students are exposed to the most current ideas, concepts and controversies because the classroom instructor in agriculture is also a designated research scientist. In addition, students benefit from the availability of equipment and facilities associated with the research responsibilities that might not be available exclusively for teaching.

Graduate education is recognized as a high-cost responsibility of the college. It is also recognized that graduate students contribute significantly to the research efforts of the college, thereby justifying the apparently high educational costs. Growth of the graduate programs, particularly at the doctoral level, reflect maturity of the col-



lege and University. Support for students and a decline in the pool of potential graduate students have added emphasis to efforts designed to attract the most highly qualified prospects. National studies and detailed surveys continue to indicate a serious deficiency in masters and a marked decline in doctoral graduates in many agricultural disciplines. The downward trend in agricultural enrollment has stabilized and seems to be reversing. Nonetheless, low enrollment in both undergraduate and graduate programs is still a concern, and some programs are increasingly difficult to justify on a cost basis. The slight upturn in freshman applications/admissions is, in part, a reflection of the comprehensive recruiting efforts of the college, which have been significantly enhanced through extramural funds.

Many employers seek practical and business experience, and the growing college internship program is helping meet this need. Affirmative action efforts are associated with both recruiting activities and special internship programs, such as the USDA-supported competitive grant program for research apprentices. Several departments have been successful in pursuing these funds in 1985-86 and previous years.

The success of the instructional programs can be measured in several ways. Demand for graduates at all degree levels is good to excellent. In addition, external support for instructional programs continues to grow. In 1985-86, the base of 110 scholarships worth more than \$75,000 was increased by \$125,000 with the first payment on the W.W. Gaston endowment by Gold Kist. This endowment, over a five-year period, will establish a scholarship fund of \$50,000, a fund of \$25,000 for a professorship, and \$5,000 per year for each of five years for recruiting and public relations. Other extramural funds totaling more than \$10,000 were contributed for recruiting activities.

During the 1985-86 academic year, two new academic programs received final approval. The college will offer an interdepartmental Ph.D. in food technology, and the Department of Food Science will supervise the Bachelor of Science degree in packaging science. This new bachelor's program will be an inter-college program with agriculture initially stressing food packaging.

#### International Agriculture

The College of Agricultural Sciences continues to serve international students. During 1985-86, six international undergraduate and 52 international graduate students were formally enrolled in college curricula. In addition, the college hosted more than 30 foreign visitors whose lengths of visits varied from a few hours to several months. A major step was made in developing a plan for the University that coordinates the international efforts in agriculture and will encourage growth in this complex area. This plan will be phased in during the coming 18-24 months.

## Continuing Education

Short courses, workshops, seminars and related in-service training activities are presented throughout the state to serve professionals and to help improve technical competency. Agriculture continues to face negative economic conditions of near-crisis proportion, which has been intensified by severe weather conditions in the past year. Technical help is essential and will depend on college programs and graduates.

## COLLEGE OF ARCHITECTURE

The 1985-86 academic year marked the 27th year of the College of Architecture. Despite the change of leadership in the dean's office, this has been a very positive and progressive year, and full credit for this success goes to the faculty, student body and Acting Dean Lamar H. Brown. When Dean James F. Barker, AIA, took over July 21, 1986, he found a healthy and stable school ready to move forward and upward.

The College of Architecture is the only school in South Carolina to offer programs in architecture, building science and management, and city and regional planning. Each of these programs is fully accredited by the appropriate national accreditation agency: architecture by the National Architectural Accrediting Board; building science and management by the American Council for Construction Education; and city and regional planning by the American Planning Association in conjunction with the American Institute of Certified Planners. In addition, the Department of Visual Arts and History offers a Master of Fine Arts degree.

The goal of the College of Architecture is to prepare the design, planning and construction professionals needed to control the physical growth of our built environment. The importance of careful and thoughtful planning and design as a contributing factor to the quality of life cannot be overemphasized. The college has achieved prominence in these areas through public service projects involving long-range planning and revitalization of communities throughout the state requiring a considerable research effort by the student team members. The interaction with real-life situations and people adds valuable experience to the educational process.

The long-range plans of the college are to continue to improve and expand the environmental design capabilities through the addition of new programs and to strengthen existing programs. New programs being pursued are a master's degree in building science and management, a bachelor's degree in landscape architecture and a bachelor's degree in fine arts. Computer-aided design as well as computer programs for construction estimating, scheduling and project control are being introduced to keep our programs current with industry practice. Additional physical facilities must be forthcoming for these new programs to become a viable factor in the college. The student population has remained unchanged for the past several years because space limitations require enrollment restrictions.



## College Program

The establishment of a computer graphics laboratory in Lee Hall will allow the college to move forward in this advancing technology. While the prime beneficiary will be the Department of Architectural Studies, the other three departments also are involved. The lab is equipped with 20 Texas Instrument Professional Microcomputers with supporting software (AutoCad), printers, plotters and digitizers. The lab also contains three Tek terminals with supporting copier and matrix camera. The software includes "Draft," a 3-D graphics package donated to the College of Architecture by Skidmore, Owings and Merrill and valued at \$60,000.

The faculty retreat at Unicoi in Helen, GA; in January allowed the faculty to examine the report to be submitted this spring for the reaccreditation of the professional programs in architecture. The entire college was involved because all departments contribute to the course work in architecture.

Faculty conducted the following public service projects: Professor George Means, Greenville Hospital System; Professor Roger Liska, Contractor's Licensing Board; Professor Jose Caban, Reedy River Project, Darlington Project and Westminster Project; Professor Lynn Craig, Florence Project and Elks Lodge Project; Professor Martin Davis, Catawba Project and Town of Jefferson Project; Professor Harlan McClure, Simpsonville Project; Professor Peter Lee, Village Project at Middleton Place; and Professor John Jacques, Congaree Vista (City of Columbia).

The Clemson Architectural Foundation sponsored a lecture series, which featured 12 nationally prominent architects and artists. Twelve Rudolph E. Lee Gallery exhibitions included works of Clemson students and faculty as well as state- and nationwide showings.

## Department of Architectural Studies

Professor John Jacques, who has served as acting department head this past year, also was the principle author of the APR Report for NAAB.

Professor Richard Norman presented the following papers: "Electronic Color in the Architectural Studio," ACADIA Workshop, Tempe, AZ, 1985; "Architecture and Electronic Color," ACSA, Vancouver, BC, 1985; and "St. John's Alley," (a residential revitalization project in Greenville, SC), ACSA, New Orleans, LA.

Visiting Associate Professor Jane Hurt submitted her Ph.D. dissertation at the University of Nottingham Department of Architecture.

Professor Harlan E. McClure, FAIA, received the "Distinguished Professor Award" at the National ACSA meeting in New Orleans, the Silver Medal of the AIA and the Silver Medal of Tau Sigma Delta. A publication, "A Study of Passive Energy Conservation in Ligurian Hill Towns," was the culmination of a Provost Research Grant.

Professor Gayland B. Witherspoon is president-elect of the South Carolina Chapter of the American Institute of Architects, and as a colonel in the Air Force Reserves, he is chairman of the Air Force Design Advisory Group.



## Department of Building Science and Management

After meeting with alumni and professionals throughout South Carolina and in Charlotte, N.C., Ralph Knowland, department head, initiated a master's program (Master of Building Science and Management). The preliminary proposal has been approved by the department, college and University curriculum committees, and the final proposal will be presented to the Commission on Higher Education during fall 1986.

The South Carolina General Contractors Licensing Board contracted with the Clemson Architectural Foundation to have the Department of Building Science rewrite the state examination. Professor Roger Liska, assisted by Professor Steve Schuette, spearheaded this effort. The new examinations are in place, and the department has a three-year contract to grade and maintain the exams for the Licensing Board. The new examinations should reflect more accurately the competence of those persons seeking a contractor's license in South Carolina.

Professor Roger Liska was awarded in April a Clemson University Provost Research Grant to pursue research on his proposal, "Diagnosis of the Tight Building Syndrome in Educational Facilities." He also signed a contract with Prentice-Hall Publishing Company for publication of his book, Formats for the Maintenance Manager. Professor Liska presented two papers, "Construction Scheduling Techniques" and "Construction Supervisory Training," at the annual meeting of the Associated Builders and Contractors in Anaheim, Calif., in February. In addition, he was elected national board member of the American Institute of Constructors and was appointed chairman of AIC's National Publications Committee. Professor Liska developed and taught two, 10-week continuing education courses in "Construction Supervision Training," at Tri-County Technical College in 1985.

Professor Steve Schuette presented a paper, "The Use of the Electronic Spread Sheet in Construction," at the National Convention of the American Institute of Constructors in Orlando, FL, in April. Professor Schuette was responsible for obtaining a donation of computer programs valued at \$3,185 for the department and developed many computer applications for use in the building science classroom.

Professor Clarence Addison attended a CADS Seminar at Skidmore, Owings and Merrill in Chicago and the A/E Exposition in Anaheim, CA. Professor Addison integrated the use of television photography into the teaching and learning processes.

## Department of Planning Studies

During this academic year, the dual master's degree program in city and regional planning and architecture was formally approved by the University and reported to CHE. (No CHE application process was required.) One student is already pursuing the dual degree.

The Committee on Landscape Architecture Program with two members from the College of Agricultural Sciences and two from Architecture finalized the Assessment of Need for the proposed program. This work as chaired by Professor Jose Caban, and a report was submitted to Vice Provost Jerry Reel. On the basis of this report, the University

decided to file a proposal with the CHE to initiate the BLA in the College of Architecture in fall 1987.

Professor Barry Nocks published a refereed article in the journal Gerontologist; presented a paper at the national conference of ACSP; completed a monograph for the Alpha Center; published a monograph on hospital planning by NTIS; had a methodology accepted by the S.C. Health and Human Services Finance Commission; and received a Provost Research Grant.

Visiting Associate Professor James London presented a paper at the national conference of ACSP; continued as director of the Water Resources Research Project with the Strom Thurmond Institute; and received approval of a proposal for the University Impact Study in connection with Clemson's Centennial activities.

#### Department of Visual Arts and History

The Master of Fine Arts graduate program had the highest number of students enrolled in its history and one of the the finest groups of graduates since the program was initiated.

The department established a close relationship with the state's major art-related institutions. Faculty served on a variety of committees within the State Arts Commission in Columbia; the department head was named to the Advisory Board of the Cultural Affairs Committee of the South Carolina State Legislature; and both graduate and faculty formed a major portion of the visual arts area of the S.C. Governor's School for the Arts.

The Bachelor of Fine Arts degree was initiated this year. The letter of intent was approved and forwarded by the University administration to the Commission on Higher Education. The proposal will be prepared this summer to be submitted in November 1986 for implementation in fall 1987.

Professor Harold Colledge published Samuel Sloan, Architect of Philadelphia, 1815-1884, University of Pennsylvania Press.

Professors John Acorn and Mike Vatalaro were commissioned by the Charleston Airport Authority to create works of art for the new Charleston International Airport. The commissions were the result of a proposal competition in which 14 artists were selected.

Professor Tom Dimond received the Award of Distinction in the annual Guild of South Carolina Artists Exhibition at Gibbs Gallery in Charleston.

Professor Sam Wang contributed to the Instructor's Manual for Photography by Phil David, University of Michigan. Professor Wang's contributions were computer programming on timing darkroom operations and an original photograph, "Hunting Island."

Four Clemson art professors, John Acorn, Ireland Regnier, Mike Vatalaro and Sam Wang, were selected for the Invitational Exhibition, South Carolina: The State of the Arts. This exhibition probably is the most comprehensive and ambitious exhibition ever organized in the state by the Columbia Art Museum.



## COLLEGE OF COMMERCE AND INDUSTRY

The College of Commerce and Industry at Clemson University comprises the business and textile educational, research and service programs. The main service functions are found in the Small Business Development Center, the Office of Professional Development and the public service component of the School of Textiles. Funded research is monitored by the associate dean and director of research, and the Center for Policy Studies has successfully attracted funds to support research in the Department of Economics. The college grants degrees in all the functional business areas and grants three textile degrees at the undergraduate level.

The college is looking forward to the next five years with an aggressive posture. Faculty and administrators believe that the economic development of South Carolina and our region will depend on expanded activities in teaching, research and service on the part of Clemson University. The College of Commerce and Industry will play a critical role in its success.

Over the past several years more emphasis has been placed on the research accomplishments of the faculty in the College of Commerce and Industry. This emphasis has been particularly evident in new hiring. We have taken care to ensure that quality teaching is maintained in the context of this new emphasis. The following (abridged) examples illustrate the accomplishments of the various units of the college.

### School of Accountancy

The School of Accountancy hosted the annual Southeast American Accounting Association's regional meeting in Greenville April 17-19. A major faculty effort was devoted to refereeing more than 180 submitted papers. One hundred and twenty-three papers were accepted and published in the proceedings. The faculty coordinated the selection process by topic with each paper sent to two blind reviewers, one inside and one outside. Attendance for the meeting, which featured the CEO of Peat Marwick and Company from New York as speaker, exceeded 560 people. This meeting enhanced Clemson's reputation among other accountants and accounting professors, especially in the Southeast.

Forty-one Clemson accounting graduates were placed with national CPA firms. This is approximately 50 percent of the 85-86 graduating class, comparing favorably with such schools as Duke, the University of North Carolina at Chapel Hill and Emory, all of which consistently place 50 to 70 percent of their graduates with national firms. Most of our regional competitors place only about 30 percent. This accomplishment speaks highly of the improving quality of our accounting graduates.

The school's publication rate hit a new high with faculty authoring or coauthoring more than 23 journal articles and two texts. About 12 papers were presented at professional meetings, plus numerous speeches to accounting organizations.



## School of Textiles

The second annual European Textile Machinery Study Tour was organized and conducted with nine students visiting dyeing, printing, and finishing operations in West Germany, Italy, Holland and Switzerland.

The oral history of the Clemson University School of Textiles was completed and exhibited for the first time. This project was well-received by alumni and friends of the School of Textiles and enhanced the credibility and reputation of the school.

The Microcomputer Laboratory was completed and is operational. Lab use by faculty, staff and students continues to increase as equipment is added and updated.

A Composite Structures Laboratory was begun with very limited equipment. The study of this highly visible and important segment of the textile industry will be greatly enhanced as this lab becomes better equipped.

Recruiting efforts produced approximately 55 freshmen, the largest number in the past three decades. This accomplishment becomes highly significant in light of the many negative comments reported in the media about the future of the textile industry in this country.

Placement and starting salaries for undergraduate and graduate students remain excellent. This continues to be one of our strong selling points in our recruiting efforts.

During the 1985-86 academic year, the School of Textiles had 49 undergraduate students on scholarships. The sum of stipends paid to these students was \$95,900. Beginning with the spring semester, stipends for the J.E. Sirrine Foundation undergraduate scholarships (we have 16) were increased from \$750 to \$2,000 per academic year. Abney Foundation scholarships were increased from \$1,500 and \$2,000 to \$2,000 and \$2,500, respectively.

## School of Business

### Department of Economics

Donald F. Gordon joined the economics faculty as Abney Professor of Free Enterprise. Professor Gordon is a world-renowned economist from Baruch College of City University of New York. Before that he was at Simon Fraser University, the University of Rochester and the University of Washington. He received his Ph.D. in economics from Cornell in 1950 and is president of the Western Economics Association. His work on Keynesian unemployment has become a classic.

Research contributions by the economics faculty include a commissioned paper by the National Science Foundation as well as numerous manuscripts.

In addition to the usual output of scholarly research, this year was devoted to a number of policy studies. Of note, the department was actively engaged in the Operation Baseline project commissioned by the State Chamber of Commerce. This project was an attempt to put into perspective the various statistical characterizations of the state. The department was primarily responsible for three sections of this report

-- state government taxation, the industrial base and the environment -- representing the research strengths of the department.

An important finding of the Baseline study was that South Carolina ranks high in what may arguably be the most important measure of taxation. Further research is being conducted in the department as part of a National Science Foundation Science Policy study. Preliminary results suggest that taxation measured in several different ways leads to a substantial decline in the growth of state income.

Several other research projects likely to have major impact on the profession are nearing completion. Topics include mergers, sexual discrimination, and international regulations on standards and labels. The department is making a concerted effort to improve the quality, acceptance and circulation of the research output rather than stressing numbers of publications.

The department again received \$10,000 from DuPont earmarked to sponsor research in environmental economics and air quality regulation. This grant is the legacy of research completed for DuPont in 1978. The department continues to rebuild the Ph.D. in Applied Economics. This was the first year of a reorganization for the Applied Economics program, which is sponsored jointly with Agricultural Economics. While some details remain to be worked out, the spirit of cooperation has reached an all-time high. The first graduate from the economics area will enter the job market in the fall.

New courses and curricula are being developed, including a strong finance orientation and concentration for master's and Ph.D. students. A course in financial economics was taught for the first time this spring.

#### Department of Finance

A major curriculum revision was completed, creating five concentrations from which students must select: corporate finance, financial institutions, international finance, real estate finance and financial accounting. These concentrations will provide more opportunities for students to specialize and increase their marketability.

Work on two grants was completed. Rodney Mabry completed his investigation of "Fringe Benefits Available to Public School Teachers in the Southeast" for the Southeastern Regional Council for Educational Improvement. This was a year-long project for about \$23,000. Perry Woodside completed his portion of the analysis of Water Utility Districts in South Carolina for the state through the Strom Thurmond Institute. Woodside's effort analyzed accounting data to determine the financial health of hundreds of these independent utilities. Work has begun on a proposal to add a Master of Finance graduate program. This effort will continue through next year. Significant time and effort were given to recruiting two highly qualified new faculty (one replacement and one new slot) in a discipline where a shortage of good people exists.

Scholarship funding was obtained from NCNB National Bank (one new \$500 scholarship) and First Union/Southern Bank (\$25,000). The department is actively seeking private financial support. Alumni giving campaigns are being developed for NCNB and First Atlanta.



## Department of Management

An Industrial Advisory Board to the Department of Management was formed in spring 1984 with 13 executives. The Board's success has led to its expansion to include the entire School of Business. The number of members was increased to 29 in fall 1985.

The Burlington Industries first endowed professorship in the department was filled with John Kanet.

The International Envelope Company, NCNB National Bank and Sonoco Industries each funded substantial scholarship programs. Alumni funded the first two Management Alumni Scholarships.

The research productivity of the faculty, as measured both by journal publications and funded research, increased substantially.

The master's and the doctoral programs were refocused and more than doubled in size. There are currently 40 doctoral students and 40 master's students in the industrial management program.

As part of a research contract with the department, IBM granted a substantial amount of software to establish a minicomputer-equipped Manufacturing Management Lab. Hewlett-Packard granted an HP-250 minicomputer, several terminals and associated software to establish a Management Support Systems Lab.

## Department of Marketing

The greatest accomplishment for the Marketing Department this year was approval from the South Carolina Commission on Higher Education for a Bachelor of Science degree in marketing beginning August 1986. A curriculum has been developed to facilitate transfer from other majors. Most initial students are expected to transfer from other majors within the College of Commerce and Industry.

Faculty recruiting has gone well this year. Two positions have been filled with tenure-track faculty, and one position has been filled with a visiting faculty member. All three have terminal degrees, teaching experience and impressive publication records.

One faculty member completed requirements for a Ph.D. at the University of Oklahoma. Now only one faculty member is not terminally qualified; however, his degree requirements should be completed this summer.

One faculty member is a major participant in a grant-funded project with the School of Nursing to attract more graduate students to that school. Another is participating in the preparation and presentation of a grant proposal with the bioengineering faculty.

Some marketing classes have gotten significant publicity this year for research projects performed for the business community. Several business owners came to campus to hear student presentations about their companies.

## Office of Professional Development

Consistent with the College of Commerce and Industry's mission to expand its influence and scope throughout the Southeast, the Office of Professional Development has worked hard in 1985-86 to strengthen its



programs and boost its enrollment. The following are some of the highlights of that effort.

On June 1, 1986, the Office of Professional Development merged with Continuing Engineering Education. PD assumed all marketing, mailing and registration responsibilities. PD and CEE intend to rely on the engineering faculty to aggressively teach and expand programs.

Already advances are being made. New national conferences in ceramics, bioengineering, laser technology, automatic identification systems, product liability and more either are scheduled for late 1986 or are planned for early 1987. These will enhance the University's image and overall ability to recruit top student and scholarship dollars in an age where high technology and engineering are essential for success.

The Office of Professional Development, widely known as one of the nation's best continuing education operations, reached a second milestone in 1985-86 with the highest enrollments and largest core course offering in its 28-year history. More than 23,000 people -- managers, technicians, CEOs, supervisors, secretaries and more -- participated in 630 Clemson University technical conferences, management seminars, training sessions, workshops and executive briefings.

Amid this growth, PD expanded its efforts onto the international scene. PD sponsored trips to China for textile magnates allowing CEOs to inspect Chinese mills and gauge competitive potential, and Australia and New Zealand, where wool executives visited the world's most innovative wool research facilities and schools to learn production processes, techniques and new ideas. Cooperative textile arrangements also were established with textile concerns in Colombia and Portugal, and the foundation was laid for another executive mission to China for hosiery manufacturers.

Meanwhile, a highly productive relationship with Courtaulds, the second largest textile company in the world, headquartered in Manchester, England, continued to flourish. Twenty-six Courtaulds managers from England, Scotland, Ireland, France and the United States visited Clemson in May for two weeks of executive development training. An entourage of PD trainers followed up that session with a visit to Manchester in June for additional in-house training.

Despite the posture of America's textile industry, textile continuing education continued to boom in 1985-86. With every new conference came a crowd of information-seekers ready to apply new skills, new technologies, new machinery in the battle against the imports or for market share in a new field.

While the traditional 40-plus textile conferences continued to attract an average of more than 40 participants, other conferences such as Polypropylene Technology and Nonwoven Fabric Forum attracted more than 100. Such remarkable success, particularly with the new polypropylene conference, reinforced the common recognition that Clemson University is on the cutting edge in textile education.

Meanwhile, PD's Electronics in Textiles conference started taking on "trade-show" status with its biggest showing ever -- 200 participants and exhibitors.

PD added two new "road trip" workshops in addition to the Shuttleless Weaving workshop -- Spinning, and Twisting and Winding. Both filled the tour buses to capacity as managers traveled from Greenville

to Spartanburg to Charlotte visiting key companies with machinery advances that are in demand.

A computer competency series begun in 1984 far superseded growth expectations and plunged into new markets in three states: North Carolina, Alabama and Florida. This series is making the Clemson University name synonymous with excellent IBM personal computer training throughout the Southeast. More than 400 courses attracting over 4,000 participants were offered in 15 major cities, including Greenville, Columbia, Charleston, Atlanta, Miami, Tampa and Raleigh.

Two ongoing programs are of particular note. First, PD Director Ralph Elliott, noting a void in the continuing education direct mail market, has taken his marketing and mailing list expertise on the road to help the continuing education units of small and large colleges and universities. "The Effective Direct Mail Marketing of Seminars and Conferences" has been extremely well received in cities like Atlanta, San Francisco, Chicago and New York. Dr. Elliott's sharing of the Professional Development system has given Clemson University positive recognition with continuing educators across the nation and is making Clemson a leading broker of continuing education information. In effect, this puts Clemson in touch with state-of-the-art information that will enhance PD marketing efforts, enrollments and the University's national recognition.

Second, PD Assistant Director Helena Douglas, working with the highly successful Professional Development for Women conference, has visibly enhanced the program in a way that has prompted high enrollment increases in the face of stiff, price-cutting competition. PD for Women, held annually in Greenville, was taken to Raleigh, where it was an immediate success, attracting more than 145 professional women. More than 150 women attended the session in Greenville.

#### Small Business Development Center

The Clemson University Small Business Development Center had a number of significant accomplishments during the past year. In addition to the primary mission of providing small business consulting, the Small Business Development Center was active in three additional areas:

For the calendar year ending December 31, 1985, the center provided consulting services to 706 current or prospective businesspersons. Of these, 95 clients were assisted for more than 12 hours. First quarter 1986 figures indicate healthy increases in client activity as compared to 1985.

Fifty-three small business seminars were conducted, serving 949 individuals during the past year.

An IBM System 36 computer system to be used in a statewide procurement network was developed. Hardware configuration and data base development work has been completed, and the system has been delivered to Columbia for program implementation.

The Small Business Development Center director and three satellite managers completed an intensive financial analysis training pro-



gram conducted by the National Development Training Council, enabling the Small Business Development Center to provide the highest level of financial analysis assistance to the small business community.

#### Center for Policy Studies

The Center for Policy Studies completed its first full year of operation. Private funding from foundations increased from \$150,000 last year to more than \$200,000 this year. The primary source of funding has been the Sarah Scaife Foundation of Pittsburgh. More local sources of support must be expanded for the future.

Eight working papers by Clemson economics faculty were produced and distributed to a national audience of academicians and selected government officials concerned with economic analysis.

The center hosted a program for the Liberty Fund, Inc., an operating foundation which attracted 16 professors from various social science and liberal arts disciplines at colleges in the Southeast. The six-day program featured a series of lectures by nationally recognized scholars in economics. This program brought these faculty into contact with members of the Clemson economics faculty and helped identify Clemson as a center of scholarly activity.

The center also coordinated research for the South Carolina Chamber of Commerce for Operation Baseline, a 10-sector study of the economy of South Carolina. Clemson faculty completed several key portions of the study; the remainder were completed by faculty at USC. The portion of the study that has generated substantial favorable publicity within the business community was the section on taxes and government spending, written by Clemson faculty.

Research support for members of the Clemson economics faculty was provided by the center. Some faculty were provided travel support not available from limited University funds; most were provided summer salary support for various research projects. This is one of the most important aspects of the center since Clemson is not competitive with major research universities in the availability of internal summer money. Some new faculty became more interested in Clemson because of the possibility of this summer research support.

The center continued to work with the State Department of Economic Education by sponsoring a one-credit college course for teachers in Greenville each semester and summer session. The center also hosted the first "Economics Day," attracting 60 high school students who came to hear Clemson faculty talk about economics as a career and about current economic issues.

The first economics briefing for newspaper editors from South Carolina was hosted by the center. This two-day briefing involved five members of the Clemson economics faculty and one from Indiana University. The editors were pleased and requested that the program be made annual.



## COLLEGE OF EDUCATION

As one of four institutions in South Carolina with nationally accredited teacher education programs at the undergraduate and graduate levels, Clemson has renewed its commitment to excellence in the teacher preparation field. As a result of attention recently focused on the teaching profession, education today has a high priority at local, state and national levels. Clemson's College of Education offers a variety of programs designed to prepare students to meet the growing demand for competent teachers and professional service personnel for schools from kindergarten through university levels. The college is the state's major producer of math, science and vocational teachers. The college also offers an excellent graphic communications program that prepares students for professional careers in the printing/publishing/packaging industries. The College of Education conducts numerous research and service programs aimed at attracting the state's brightest students to teaching careers, improving the quality of graduates entering the teaching profession, and expanding the opportunities and enhancing the capabilities of those already in the profession.

Clemson is a leader among South Carolina institutions in providing support services for local school districts, teacher organizations, teachers, administrators and industries. Graduate classes are offered in the evening to accommodate the needs of teachers and administrators from nearby schools. In addition, a number of special institute courses for graduate credit are designed and taught in off-campus locations to meet unique needs of school districts.

During 1985-86 the college and its programs were evaluated by the Commission on Higher Education and the Department of Education and reviewed by the Clemson Board of Trustees. The college also started preparing for an evaluation by the National Council for Accreditation of Teacher Education in 1988. The first phase of these preparations involves an extensive internal program analysis to guarantee compliance with new, upgraded accreditation standards. This analysis, which will take more than a year to complete, is under way. These evaluation and accreditation activities reflect the increased level of accountability demanded by the education reform movement.

### Instruction

During 1985-86, the Department of Industrial Education granted its first seven Ed.D. degrees under the vocational technical education program initiated in 1981. A joint project involving the College of Sciences and the College of Education produced a \$50,000 CHE grant to establish the state's only Center of Excellence in Math Education. The project is designed to increase the number of public school teachers certified to teach math and upgrade the skills of math teachers.

The Department of Elementary and Secondary Education received a three-year grant from the U. S. Department of Education to train special education teachers to work with handicapped students in public secondary schools (\$71,000 first year).

A contract for the renovation of Godfrey Hall was awarded in August 1985, and construction began in September. Instructional laboratories are scheduled to be completed in December 1986. The building, completely stripped of all asbestos, was redesigned to include most of the industrial education laboratories. There also are laboratories for drafting, electricity/electronics, graphic communications (basic and advanced), printing (offset, gravure, flexography, screen, etc.), photography, microteaching, industrial training, instructional resources and computer applications. Laboratories for arts and crafts, plastics and power technology continue to operate on a lower level of Godfrey Hall. When the renovation is completed, the bulk of education programs will be housed in Tillman and Godfrey halls, both asbestos-free buildings.

The industrial arts education program in the Department of Industrial Education was renamed "industrial technology education" to conform with changes in the State Department of Education and national organizations. The technology of industry in four major cluster areas was updated: communications, construction, manufacturing, and power and transportation. Teachers of industrial technology education are prepared to give middle school and junior high school students exploratory experiences in the current technologies of industry. The major purpose of this type of program is to give students the opportunity to become technologically literate and to make career choices toward further education and training.

The Learning Resource Microcomputer Lab operated on a 12-hour daily schedule to help students upgrade basic skills. This program served approximately 150 students per week. Another computer lab in Tillman Hall was used to teach classes in educational applications of microcomputers. More than 150 students completed this three-credit class.

### In-Service

During 1984-85 the College of Education offered 80 off-campus courses at 45 locations throughout the state. Enrollment in these courses was 1,275. Also, 44 courses in mathematics, science and computer education and reading were taught with funds from the State Department of Education; 782 teachers were enrolled in these courses.

### Research and Grants

In addition to the Center for Excellence in Math Education and the Secondary Special Education grants mentioned under instruction, the Elementary and Secondary Education Department also received a \$17,000 planning grant from the U.S. Department of Education to develop teacher incentive structures.

Donations of more than \$294,937 in equipment and supplies came from industries supporting Industrial Education programs during the past year. One equipment item -- a color scanner from D.S. America, Inc. -- is valued at \$120,000. Several industries have committed to donate equipment after Godfrey Hall has been renovated. These dona-



tions will enable Industrial Education faculty to teach "state-of-the-art" technology.

The State Department of Education provided a \$60,574 grant to continue the Trade and Industrial Teacher Education program during 1985-86. In addition, two small grants (\$2,624 and \$3,346) were awarded to evaluate and revise two courses required in the T&I teacher education program. The Clemson Alumni Association provided funds to produce a college newsletter to be sent to 6,000 alumni and friends of education each spring and fall; to update, expand and improve teacher placement services; and to conduct a college faculty development program.

### Special Activities and Services

Last year the College of Education provided a variety of services to the South Carolina Department of Education, school districts and teachers continuing their education. For example:

- o Special institute graduate courses on the educational applications of computers were taught in several school districts.

- o The Clemson Writing Project, a joint venture of the College of Education, the College of Liberal Arts and seven nearby school districts, worked with classroom teachers to help teach writing in the public schools.

- o In cooperation with the State Department of Education, two special institutes were planned for public school teachers for summer 1986. One institute was designed to bring elementary teachers to Clemson to develop a curriculum guide for the infusion of "Technology Awareness" into the K-6 curriculum. Teachers participating in this institute are to establish pilot programs in selected school districts during fall 1986.

- o Another institute was established to bring industrial arts teachers to Clemson during summer 1986 to help them expand their skills as industrial technology teachers. They were asked to update the curriculum and prepare a teaching plan to implement industrial teaching technology education into selected schools during fall 1986. These programs are to serve as models for other school districts to adopt.

- o The annual Clemson Reading Conference provided an opportunity for reading and elementary teachers to hear national leaders discuss ways to improve reading instruction in the schools.

- o The Office of Educational Services and Placement welcomed 65 school districts to campus. The district recruiters conducted approximately 900 interviews with Clemson teacher candidates.

Through this variety of programs, Clemson has attempted to expand the opportunities for public school teachers and students throughout the state. In addition, the Department of Industrial Education, in cooperation with the South Carolina Vocational Association, provided special training for 41 individuals from industry during 1985-86. The demand for industrial training was greater than could be provided, and plans have been made to expand this program when the new facilities are completed in Godfrey Hall.

Army and Air Force ROTC programs provided more than \$476,000 in



academic aid for Clemson University students during 1985-86. There were 166 students attending Clemson on ROTC scholarships worth \$427,000. Nonscholarship ROTC students received \$49,200 in stipends.

The AFROTC student organization, the Arnold Air Society, won national recognition as "Best in the Nation," while an Army inspection team found the Clemson Army ROTC program "a top-notch program in every respect." The Army Inspection Board president noted, "This is the most impressive staff...I have seen on all my visits this year to the Carolinas and Georgia."

## COLLEGE OF ENGINEERING

Growing recognition of the critical role that engineering manpower plays in maintaining this nation's technological preeminence has created a great demand for qualified engineers in industry, government and education. To meet this demand for more engineers while maintaining quality in education, research and public service, Clemson University's College of Engineering continues to improve the efficiency and quality of both its faculty and curriculum.

The college received a record amount of gifts and contributions this past fiscal year, and research contracts and grant awards were greater than in any past year. In June 1986 Clemson University received from Bob and Betsy Campbell of Gaffney stock valued at \$1.05 million to establish the nation's first chair in technical communications, the Bob Campbell Chair of Technical Communications. This is the largest single gift to Clemson in the school's history. The colleges of Liberal Arts and Engineering will work together on this project, which is aimed toward increasing students' written, oral and graphic communications skills.

The college is aggressively expanding its role as a major research institution through its two research centers, the Center of Automated Manufacturing Technology and the Semiconductor Device Reliability Research Center. Reports on these centers are in the "Research" section of this report. Proposals have been made for three centers and an institute, the Center for Computer Communications Systems, Center for Engineered Ceramic Manufacturing, Center for Advanced Engineering Fibers and Institute for Material Research. Each area is supported by faculty with recognized expertise in that area.

During 1985-86 W.B. Barlage joined the dean's office as associate dean of graduate studies. Dr. Barlage, professor and former department head of chemical engineering, replaced E.H. Bishop, who returned to teaching and research in the college's Department of Mechanical Engineering. S.S. Melsheimer, professor of chemical engineering, is acting head of the Chemical Engineering Department.

Several new developments were made in the area of instruction. The freshman engineering program was begun; a Ph.D. program in ceramic engineering was approved by the Commission on Higher Education subject to later review; and an M.S. specialization in automated manufacturing systems was approved by the Commission.

The Bioengineering Alliance, comprising Clemson University, the Medical University of South Carolina and the University of South Carolina, was implemented in August 1985, and a director was named. The program is administered in the Bioengineering Department at Clemson.

The Hunter Scholars Program was begun in fall 1985 to honor Thomas M. Hunter, an outstanding engineering alumnus celebrating his 100th birthday in September 1986. The program will fund scholarships for the recruitment of outstanding engineering students. More than \$7,000 in commitments has been received to date.

The college has initiated and participates in many public service activities. This past year the Department of Civil Engineering was selected by the Federal Highway Administration and the S.C. Department of Highways and Public Transportation to be the lead agency for the Transportation Technology Transfer Service (TTTS) in South Carolina. The purpose of TTTS is to upgrade the efficiency and level of local transportation service through continuing education, outreach and delivery of essential information on transportation technology. Cooperating universities include the University of South Carolina, The Citadel and South Carolina State College. For more on the public service activities of the college, see the "Public Service" section of this report.

In July 1985, 25 engineering students and Dr. and Mrs. J. Campbell Martin traveled to England for Clemson University's first engineering study abroad trip. The host school was Bristol University, located near London. Dr. A.W. Bennett, department head of Electrical and Computer Engineering, initiated the program in conjunction with Terrence Foster of Bristol University. Bristol University was chosen because of the town's technological heritage.

In November 1985 Clemson University's chapter of Tau Beta Pi, the national engineering honor society, was named "most improved" from among the 195 chapters nationwide. One of our civil engineering graduates and a former president of Tau Beta Pi, H. Allison Smith, became the society's first Centennial Fellow, the highest honor of Tau Beta Pi.

### Instruction

The College of Engineering is the largest academic unit on campus in terms of enrollment and degrees granted. Fall 1985 enrollment was 3,350; 2,985 of these were undergraduates and 365 were graduate students. For 1985-86, a record 611 baccalaureate degrees were awarded, in addition to 114 master's and 10 doctoral degrees.

The freshman engineering program officially began in fall 1985 and is directed by R.D. Holstead, who joined us last year after 19 years as a professor of mechanical engineering (seven years as department head) at Louisiana Tech University. Entering engineering students are now required to complete a common freshman year, after which students with satisfactory grade point averages can transfer into their desired engineering majors. This new program is beneficial for students as well as faculty in that it will provide an opportunity for more freshman students to consider engineering as a career, a uniform level of competence for freshmen that will enhance success in the



professional programs, and experiences that will enable each student to better select a specific discipline as his or her major. The program improves advising during the critical freshman year and is constructed so that should a freshman choose, he or she could transfer to any program at Clemson University without losing any credits. Enrollment in the freshman program in fall 1985 was 730. Enrollment for fall 1986 is projected to be 1,000.

Several other instructional programs were approved or initiated during the 1985-86 fiscal year. A proposal was submitted to the Commission on Higher Education on February 12, 1986, for the establishment of a Ph.D. program in ceramic engineering. The Commission approved the program subject to final approval by a review team in spring 1987. Clemson is nationally known as a leader in ceramic engineering and is one of only 11 colleges in the country with an accredited ceramic engineering department.

In May 1985 the Commission on Higher Education approved a request from Clemson to establish the state's first Ph.D. degree program in computer engineering. The program began in fall 1985.

On July 11, 1985, a master's degree specialization in automated manufacturing systems engineering was approved by the Commission on Higher Education. Three departments, Electrical and Computer Engineering (ECE), Industrial Engineering (IE) and Mechanical Engineering (ME), are participating in this program.

Many engineering students found the Cooperative Education Program to be an increasingly important component of Clemson University's curriculum. The program provides students with challenging industrial work experience related to their college curriculum and is sponsored by approximately 200 Southeastern companies. During 1985-86 more than 82 percent of all participants in the Cooperative Education Program were engineering students.

Starting salary offers for B.S. graduates in engineering remain high and continue to be a negative incentive for graduate school attendance. The average starting salary (nongovernment) offered to December '85 and May '86 Clemson engineering graduates with B.S. degrees was a record \$27,551 per year. With more students wishing to enter the B.S. degree programs to meet industry demand and comparatively fewer Ph.D. graduates, the engineering education profession is experiencing major faculty shortages. Although the College of Engineering is being challenged to meet the demands of industry, a goal of excellence in education for all of its students remains the primary objective.

The demand for women and minority engineers also continued to increase in the past year. In response to this, minority enrollment in the college increased from 220 in fall 1984 to a record 239 in fall 1985. This increase counters the national trend in which minority engineering enrollments are declining. Fall 1985 figures show that women comprise more than 17 percent of the total enrollment in the College of Engineering and more than 20 percent of the freshman class.

Clemson University officially was accepted into membership in the National Consortium for Graduate Degrees for Minorities (GEM) in October 1982. The primary purpose of GEM is to increase minority enrollment in engineering graduate schools. The first Clemson GEM student



received an M.S. degree in computer engineering in December 1984, and the second will graduate next year. Another new award, to a junior engineering student, was made during the 1985-86 fiscal year.

The Summer Engineering Minority Program for High School Students marked its ninth year in 1985-86 and continues to be a success. This program is directed by R.W. Snelsire, associate professor of electrical and computer engineering. More than 780 qualified students have participated in this program. Both this program and a minority scholarship program are sponsored by industry and foundations.

Industry provides considerable support to the College of Engineering for enhancing educational opportunities for students, especially through gifts of major equipment. The Department of Bioengineering received a blood gas analyzer and supplies worth more than \$15,000 from St. Francis Community Hospital. Another blood gas analyzer was loaned to the department on an indefinite basis by the Anderson Memorial Hospital.

The Department of Chemical Engineering received a grant worth \$50,000 (over two years) from Eastman Kodak Company to help purchase a Rheometrics mechanical spectrometer for the polymer processing program. Also, Texas Instruments, Inc., gave the department a fully equipped PM-550 process control computer valued at \$35,000 for the process automation program.

Power One, Inc., donated more than \$16,000 worth of power supplies to the Department of Electrical and Computer Engineering (ECE). NCR Corporation donated \$80,000 worth of personal computers as well as a tower computer worth \$30,000. These gifts to ECE will support a computer systems integration laboratory that will allow students to use personal computers to study the monitoring and control of processes used in the equipment manufacturing industry. Texas Instruments gave the department \$88,000 to equip an image processing laboratory at Clemson. The facility will enable researchers to study computer manipulation of graphic images.

Within the Department of Electrical and Computer Engineering, the summer master of engineering program, begun in 1980, is funded totally by AT&T Technologies. Sixty-two students were enrolled for the first session of summer '86. This year's graduating class contains eight students who will receive M. Engr. degrees, bringing the total number graduated from this program to 40. Another successful ECE program is the industrial graduate fellowship program, which was established to encourage outstanding U.S. citizens to attend graduate school. To date, 18 M.S. students and five Ph.D. students have participated. Each student receives a fellowship of \$3,000 - \$5,000, a summer job opportunity and a graduate assistantship, providing total support ranging from \$10,700 to \$12,500 for the academic year.

The Department of Chemical Engineering has set as a primary goal strengthening its graduate/research program. The Master of Science Industrial Residency Program is contributing significantly, bringing financial support and highly qualified students into the graduate program. Currently, six students and more than \$165,000 in industrial commitments are involved. Twenty students and seven companies have participated since the program's inception in 1981-82.

The College of Engineering faculty's dedication to quality educa-

tion and an enriched student environment can be seen in the number of awards presented to the engineering faculty. (Additional awards are mentioned in the "Research" section below.) D.J. Dumin, professor of electrical and computer engineering, received an IEEE Outstanding Branch Counselor/Adviser Award for 1986. Only 10 such awards may be given each year, and there are more than 540 IEEE branch counselors and more than 130 branch chapter advisers throughout the world.

In February 1986, L.T. Fitch was named Alumni Professor of Electrical and Computer Engineering, distinguishing him as one of Clemson's most outstanding teachers. C.O. Huey, Jr., professor of mechanical engineering, was selected as a recipient of the AT&T Foundation Award for excellence in teaching for his dedication to the education of students.

In April it was announced that J.L. Burati, associate professor of civil engineering, was the recipient of the 10th annual McQueen Quattlebaum Faculty Achievement Award given each year to the engineering faculty member who has shown exemplary leadership in the profession during that year. Excellence in teaching, research and public service are considered in the selection. Also in April, R. Kumar, assistant professor of mechanical engineering, was awarded the 1985-86 Byars Prize for Excellence in Teaching, established to recognize outstanding undergraduate teaching in engineering mechanics.

## Research

Clemson University continues to be a leader in engineering research among institutions of higher education in South Carolina and the nation. Engineering research at Clemson has three essential objectives: to seek new knowledge, to seek answers to both the short- and long-term problems of the state and nation, and to support advanced-level educational programs by providing research experience for students.

The College of Engineering at Clemson traditionally receives a greater percentage of research funds (30-40 percent) from industry than do engineering departments at most other universities. The dollar amount of contracts and grants has increased each year for the past four years, with a record-breaking \$7.6 million of funded grants and contracts in force for research in 1985-86. The coming year looks even more promising. In July 1986 alone, the college received more than \$1,224,000 in awards and new commitments. During the past year, 96 faculty were engaged in research. Their efforts were supported by 218 graduate and 119 undergraduate students.

The Center for Semiconductor Device Reliability Research, which was formed to provide an academic focal point for the study of semiconductor component degradation after manufacture, completed its second full year of operation. Research projects involving seven faculty and eight graduate students are under way on both very large scale integrated circuits (VLSI) and solar cells. Support for the center was divided between industrial firms (30 percent) and government (70 percent). Billings last year were \$525,316, up from \$484,312 the previous year. Interest in the reliability of solar cells has declined, primarily because of the oil glut, but concern regarding VLSI devices has in-



creased within the past year as these devices become more pervasive and more complex. In addition to research contracts, the center received a \$10,000 grant from Texas Instruments for graduate student support and a Ph.D. fellowship from the U.S. Army Research Office. The Ph.D. fellowship was obtained as a result of national competition and will contribute \$131,868 over three years to support a Ph.D. candidate studying microelectronic device reliability. Measurement instrumentation worth \$160,000 was added to the center during 1985-86.

Approved by the S.C. Commission on Higher Education in 1981, the Engineering Center for Automated Manufacturing Technology (CAM) continued to grow in 1985-86 under the direction of F.W. Paul, McQueen Quattlebaum Professor of Mechanical Engineering. The research center has two industrial sponsors, Reliance Electric Company and the Torrington Company, and one industrial affiliate, Kellogg-Rust. Several new funded contracts were received this year from Sunstrand Corp., American Society of Mechanical Engineers (ASME), U.S. Army, Mohasco Carpet Co., and E.I. du Pont de Nemours Savannah River. Efforts continued to encourage the submission of externally funded research contracts through the granting of four CAM Center-funded Faculty Research Initiation grants. Goals for 1986-87 include increasing industrial CAM Center membership and participation, doubling the number of research contracts submitted through CAM, and participating in AM86 in Greenville, S.C., as a program sponsor.

A partial list of other projects gives an indication of the scope and breadth of engineering research at Clemson:

- o Engineers and scientists in the Department of Bioengineering continue to receive national and international attention for their research in biomaterials and prosthetic devices. Research projects are under way to better understand bone physiology and the influence of bone fixation on the fracture healing process. Evaluative studies are being conducted on a novel surface for skin implants. Basic studies are under way investigating collagen formation in the pores of arterial grafts. The emerging technologies of artificial intelligence, computer-aided design and computer-aided manufacture are being combined to develop novel diagnostic and manufacturing systems for custom prostheses. Artificial intelligence computer techniques are being developed to better diagnose heart disease.

- o In the Department of Ceramic Engineering, research projects in traditional and advanced ceramics are receiving increased emphasis from the faculty. Structural clay ceramics, a traditional ceramic field, received the most support from industry. A sponsored project on freeze-thaw behavior was begun, and a sponsored project on moisture expansion continued. Work on containing radioactive waste continued under the sponsorship of the Savannah River Plant. A project sponsored by the American Iron and Steel Institute on the influence of steel impurities on the life of ladle linings was completed. Work sponsored by the Army on V02/glass thermal switches continued.

- o Also in the Ceramic Engineering Department, unsponsored work to develop and characterize damage-tolerant carbon fibers is continuing. New work has begun in the area of producing oxide fibers. Fibers have been grown in several ceramic systems. A project sponsored by the S.C. Energy Research Commission to continue previous work on relating



fiber cross-section shape to damage tolerance has also begun.

- o In Chemical Engineering, the Program for Polymer Processing continues to receive both national and international recognition. Research on the production of carbon fibers and composite materials has led to the formation of a research group involving four departments focused on advanced engineering fibers. Clemson's increasingly successful and influential Fiber Producer conference, chaired by a chemical engineering professor, contributes to the recognition of the polymer program. The thermodynamics program enjoys international stature in the area of molecular simulation of fluids. Research in high pressure phase equilibrium and supercritical fluid extraction is developing rapidly.

- o Researchers in the Department of Civil Engineering, using a wind tunnel and tests on full-scale studies, are working to help structural engineers and contractors understand how structures react to wind. Results of this research may be particularly useful for buildings in areas prone to tornadoes or hurricanes.

- o In the structures area, the Department of Civil Engineering is conducting experimental and analytical research on a project to understand the behavior of composite masonry walls subjected to earthquake loads. Other research in the structures area is being conducted on mathematical models to simulate cracking in reinforced concrete, satellite separation dynamics, flexible pole shipboard retrieval systems, and soil-structure interaction.

- o Faculty working in the Clemson Hydraulics Laboratory, part of the Civil Engineering Department, completed the following five studies the past year: evaluation of storm water inlet designs, measurement of evaporative losses from irrigation systems, development of a methodology for establishing instream flow requirements and predicting flow deficiencies, wind tunnel study of air currents in the Clemson University football stadium, and a study of cohesionless sediment transport in steep channels. Three multi-year studies were continued: natural ventilation in typical S.C. buildings, heat loss from cooling pines at the Savannah River Plant, and development of a numerical model capable of predicting the transport and fate of contaminants in surface waters. New research projects were initiated to study the formation of ebb tidal shoals at tidal inlets, study contaminant transport in the unsaturated zone, conduct a physical and numerical model study of pollutant transport at the Savannah River Plant, and enhance a finite element cohesive sediment transport model for use in modeling pollutant transport.

- o In the construction and materials areas in civil engineering, research is continuing in the field of asphalt pavements, including studies on asphalt stripping, asphalt chemistry and use of nuclear asphalt content determination procedures. New research is under way on the identification and analysis of quality-related problems in the construction industry and on the development of procedures to track the costs and benefits of quality-management programs in construction. Additional research is being implemented in the area of ultra-high strength portland cement concrete.

- o Solar cell reliability research, sponsored by the Jet Propulsion Laboratories for the Department of Energy, continued in the Department of Electrical and Computer Engineering. Total expenditures

since December 1977 for this project have been \$1,097,984.

- o Electrical engineers continue the study of fabrication and properties of very small transistors. The project has received more than \$350,000 in research support from the Office of Naval Research, the Rome Air Development Command, the Naval Research Labs and the National Bureau of Standards. The program is continuing and will be expanded in the coming year.

- o The Semiconductor Research Corporation (SRC), a consortium of 35 semiconductor companies, continued support of the Center for Semiconductor Device Reliability Research. To date, SRC funding has amounted to more than \$1 million. Support from DoD and private industry has added another \$800,000 for VLSI reliability research at Clemson.

- o The Department of Defense and Texas Instruments are supporting electromagnetics and microwaves research in the Electrical and Computer Engineering Department through research and equipment grants totaling more than \$500,000. This work has resulted in the construction of a ground plane at Clemson for antenna research.

- o Plans are nearing completion for a \$2 million microelectronics facility to be constructed in Riggs Hall. This Clean Room will permit graduate and undergraduate students to design and lay out integrated circuits and fabricate structures for reliability studies.

- o The Savannah River Plant has supported work on a biped robot at Clemson. The robot is controlled by several microcomputers and has already demonstrated a dynamic walking capability.

- o Environmental systems engineers have focused the majority of their research efforts on the treatment of hazardous wastes. These research efforts are being supported by numerous grants, including a major one from the Environmental Protection Agency.

- o Engineering graphics faculty are researching sediment transport on steep slopes for the S.C. Water Resources Research Institute.

- o In the Department of Industrial Engineering, a Torrington Company/CAM Center project is being conducted to investigate the synchronization of material flow in discrete parts manufacturing. A research project is also being conducted through support from the U.S. Navy to investigate human-computer interfaces in command and control applications. The department has received two grants from the Tandy Corporation to support laboratory development and research in computer-aided manufacturing.

- o With support from the National Science Foundation, NASA, the South Carolina Energy Research and Development Center, NCR, Dupont and Carre, Inc., several different energy systems are being investigated in the Department of Mechanical Engineering. These include packed beds, phase-change thermal energy storage, fluidized beds, dynamic hyperfiltration membranes, process drying, cooling of electronic devices and low pressure ratio/high efficiency gas turbines. Fundamental engineering research in separated flows with heat addition, natural convection in enclosures, thermal plumes and single droplet evaporation also is being conducted.

- o In the area of applied mechanics and advanced engineering materials in the Department of Mechanical Engineering, the principal research activities are focused on the behavior of composite materials and metals. Research programs are being funded by NASA, Lockheed, Sun-



strand, DoD, Torrington and Carre, Inc. Both analytical and experimental studies are under way. The latter are being conducted in modern materials testing and materials processing laboratories. Research in the areas of thermal buckling of railroad tracks and the dynamics of railroad vehicles is being supported by the American Association of Railroads.

o Research activities in the Mechanical Engineering Department in the area of robotics and flexible manufacturing have attracted national and international attention. Research activities include the investigation of industrial robots, end-effectors or smart hands, computer-aided design of forging dies, near net shape techniques and computer-aided selection of materials for gears. Advanced development of a robot fabric handling system and an automated yarn loading process for textile manufacturers is under way. Funding for these activities has come primarily from the private sector.

### Faculty Achievements

Several members of the college faculty received special recognition in 1985-86 for their accomplishments in research and public service. For his innovative research on paving and construction materials, associate professor of civil engineering J.L. Burati, Jr. received a Presidential Young Investigators (PYI) Award from the National Science Foundation. The Presidential Young Investigator Awards program was established in 1983 as a way to keep the nation's most promising and outstanding young scientists and engineers on American campuses. Dr. Burati is the second College of Engineering faculty to be selected for this award in the two years the PYI program has been active.

In late spring 1986, G.C. Robinson, professor and former head of ceramic engineering, was awarded the highest honor given by the American Ceramic Society, a Distinguished Life Membership. Robinson is one of only two in the nation to have received that honor this year.

In April 1985 B.C. Dysart, professor of environmental systems engineering, was elected to chair a Rene Dubos Center for Human Environments, Inc., forum in New York on national land use management. Dr. Dysart was recently conferred the Bald Eagle Statue for his two years of service as president and chairman of the board of the National Wildlife Federation.

Three faculty in the College of Engineering were elected to the grade of fellow in professional societies in 1985-86. J.C. Jennett, professor of environmental systems engineering and dean of the college, was elected a fellow of the American Society of Civil Engineers (ASCE). J.Y.S. Luh, Quattlebaum Professor of Electrical and Computer Engineering, was elected a fellow of the Institute of Electrical and Electronics Engineers (IEEE). And T.T. Yang, professor of mechanical engineering, was elected a fellow of the American Society of Mechanical Engineers (ASME).

Several faculty were elected to leadership positions in professional societies during the past year. These include: A.W. Bennett, professor and head of ECE, chairman of the Southeastern Association of Electrical Engineering Department Heads; J.C. Jennett, dean of the

college and professor of environmental systems engineering, vice president of the Piedmont Chapter of the South Carolina Society of Professional Engineers; and T.H. Oswald, director of Continuing Engineering Education and professor of engineering technology, president of the Piedmont Chapter of the South Carolina Society of Professional Engineers. C.E.G. Przirembel, professor and head of mechanical engineering, was recently appointed to the Projects Board of the American Society for Engineering Education (ASEE). This board of ASEE is responsible for the development, approval, management and operation of all projects formally involving the society.

The college's faculty continues to receive national and international recognition. J.Y.S. Luh, McQueen Quattlebaum Professor of ECE, was invited to be a member of the Science Council's International Panel of Advisers for Engineering/Physical Sciences, Science Council of Singapore. R.H. Brown, professor and department head of civil engineering, was one of 12 NSF-supported delegates to the Seventh International Brick Masonry Conference held Feb. 17-20, 1986, in Melbourne, Australia, where he presented a paper, "Performance of Retrofit Embedments in Brick Masonry," co-authored by a civil engineering graduate student. Bioengineering Professor F.W. Cooke spent 12 weeks at the U.S. Army Medical Complex at Walter Reed Medical Center in Washington, D.C., in August and September. Dr. Cooke led an interdisciplinary team of engineers, surgeons, pathologists and physiologists in the study of porous high-density polyethylene as a possible replacement for bone and cartilage in plastic surgery. The National Science Foundation awarded Clemson a grant to host the second National Conference on Issues and Future Directions in Electrical and Computer Engineering Education and Research at Hilton Head. The first national conference was hosted by Clemson in 1985.

Four faculty members had books or manuals published in the past year. F.C. Alley, professor of chemical engineering, co-authored with C.D. Cooper (University of Central Florida) Air Pollution Control: A Design Approach, published by Prindle-Weber-Schmidt. J.L. Hammond, professor of electrical and computer engineering, co-authored with P.J.P. O'Reilly Performance Analysis of Local Computer Networks. D.L. Ryan, associate professor of engineering graphics, published two books: Computer-Aided Graphics & Design, second edition, published by Marcel Dekker, Inc., and Modern Graphic Communication: A CAD Approach published by Prentice-Hall. N.R. Bauld, Jr., professor of mechanical engineering, published the second edition of his textbook, Mechanics of Materials, by Brooks/Cole Publishing Company.

#### Public Service

The Continuing Engineering Education (CEE) Program is the primary public service arm of the College of Engineering. As such, it is the vehicle by which the University serves the lifelong learning needs of the region's practicing engineers. The advancement of technology and the increasingly competitive environment in which engineers must operate mandate a constant renewal of technical competence. The CEE program strives to remain in touch with the engineering community and to



offer the most needed seminars, short courses and conferences.

In the program year 1985-86, CEE conducted 20 seminars and short courses, eight major conferences, 123 professional engineering reviews and five in-house training courses. These offerings involved a total of 236 program days with a total enrollment of 5,449. In addition, CEE cosponsored with the Office of Professional Development (College of Commerce and Industry) 208 one-day seminars on microcomputer competence, word processing, electronic spreadsheets and database management software. Total registration for these seminars was 2,048.

Subjects represented in the overall program included both high technology and other, more conventional areas. The high-tech offerings included fiber optics, nuclear industry use of membrane technology, artificial intelligence, lasers and plant-wide control systems. The management of toxic and hazardous wastes was the subject of a very successful seminar and conference, and more programs are planned in this area for the coming year. Other programs included those on electrical power systems, motors and variable speed drives, vibration analysis, maintenance management, HVAC and HVAC control systems, waste disposal systems and statistical process control. The Center for Semiconductor Device Reliability Research sponsored workshops on submicrometer device reliability and technologies of ultrasmall electronic devices. Highways and paving once again were popular subjects, with one conference and two seminars on asphalt paving. CEE also hosted the 15th annual S.C. State Highway Conference. CEE continued to offer review courses to prepare engineers to take the Engineer-in-Training and Professional Engineer examinations. A special Civil Engineering Review series was conducted for the U.S. Navy at Pensacola, Fla. Another public service activity was CEE's facilitation of the annual MATHCOUNTS contest for the S.C. Society of Professional Engineering, Piedmont Chapter.

At the close of the 1985-86 program year, Continuing Engineering Education merged a large portion of its operations with Professional Development. CEE will continue to bear the same name and general thrust of its program. The CEE director, T.H. Oswald, will remain on the engineering dean's staff and will be responsible for CEE program development, content and quality. Major economies of scale will result from the merger, as well as significant growth in the program.

In spring 1985, the CEE director began an in-depth investigation of the feasibility of offering Clemson University graduate and non-credit courses to participants off-campus by means of live, interactive instructional television. In late 1986 the S.C. ETV Network will inaugurate service from its Instructional Television Fixed Service (ITFS) system. ITFS will broadcast programs from universities and other public agencies to be received by any organization having the proper reception equipment. Industrial plants, consulting firms, military and government installations, hospitals, schools, etc. will be able to receive programs in "real time" with the class session on the Clemson campus, and students will be able to participate in class discussions via dedicated telephone lines to the instructor's podium.

In June 1985, CEE was successful in a proposal to Daniel International for the planning phase of a system of continuing professional development courses, both non credit and graduate level. These cour-

ses will be taught in the Daniel facilities and will, in part, incorporate video-based instruction techniques.

## COLLEGE OF FOREST AND RECREATION RESOURCES

The College of Forest and Recreation Resources is truly the forest and recreation resources center for South Carolina. All teaching, research and Extension activities in forest management, wood utilization, recreation resources and services, and tourism management are the responsibility of two departments -- the Department of Forestry and the Department of Parks, Recreation and Tourism Management.

The college was founded in 1970 to promote the wise management, use and stewardship of the state's forest resources and to enhance the quality of life of its people through a rewarding use of leisure. When one realizes that the forest products industry adds more than \$3 billion (approximately 27,000 employees) and that recreation and tourism also contribute more than \$3.4 billion (more than 80,000 employees) annually to the economy of South Carolina, this college's important functions are easily recognizable.

### Department of Forestry

The Department of Forestry's programs in education, research and Extension are unique within the state of South Carolina. The department plays an important role in educating many of the foresters who manage the 12.5 million acres of forest land in the state. Clemson's curricula in forest management and wood utilization emphasize the role of the forester as a steward of forest resources, and research programs emphasize problem-solving and gaining fuller understanding of the forest and its use. Extension programs are designed to be sensitive to the needs of forest landowners with special emphasis on small, private landowners.

#### Teaching

During the academic year, 18 candidates received the Bachelor of Science degree. Ten graduate degrees were awarded: five Master of Science degrees, four Master of Forestry, and the second Ph.D after initiation of the program more than four years ago. A minor in forestry also was approved during the year.

For the sixth consecutive year, the forestry faculty taught two three-week continuing education sessions in silviculture to U.S. Forest Service personnel. Also, for the third year, the department sponsored the U.S. Forest Service short course on Sale Layout and Timber Harvesting. This six-week course brought in foresters from all over the eastern United States.



## Research

Research in the Department of Forestry is conducted in timber production, forest management, wood utilization and biological productivity and is supported by state appropriations, federal McIntire-Stennis funds and outside grants. As a group, the forestry faculty produced approximately 65 scientific and professional publications including 10 department bulletins and research papers.

The timber-production area is made up of a group of scientists in forest soils, silviculture, entomology, genetics, pathology and tree physiology. They are concerned with problems that prevent full timber productivity.

Some of the major ongoing projects in this area are: biology and production of littleleaf-affected shortleaf pine stands; effects of nursery practice and field performance as related to the physiological properties of loblolly pine; use of prescribed fire as a primary means of site preparation after clearcutting in southern hardwoods; and the effect of carbon dioxide enrichment on containerized loblolly pine seedlings.

Another 14 projects are supported by grants from the United States Forest Service, other federal agencies, private industry and state agencies. Grants received this past year were as follows:

- o Establishing priorities for the assessment of biological and economic impacts of major forest pests in the Southeast. \$35,292. USDA Forest Service.
- o Developing a growth model for natural loblolly pine stands. \$15,000. USDA Forest Service.
- o Tip moth damage/growth phenology and morphology relationships among loblolly pine families. \$10,000. Weyerhaeuser Corp.
- o Intraspecific variation and physiology of loblolly pine to waterlogged soils. \$187,000. USDA Competitive Grants.
- o Evaluating drought impacts on the growth of southern pine forest. \$25,000. USDA Forest Service.

Publications from projects in this area were numerous and diverse. Among them was a handbook for small landowners entitled "Forestry Acre by Acre," which describes management techniques for improving low quality oak-pine woodlands. Other publications gave results on sediment and nutrient export in runoff from burned and harvested pine watersheds in the South Carolina Piedmont, defined crop tree quality in young Piedmont oak stands of sprout origin, and revealed the genetic variation in susceptibility to coneworms in young loblolly pine seed orchards.

Research in the forest management area seeks solutions to forest-based, multiple-use problems. Major areas of research include investigation of habitat utilization by wild turkey poults in the Southern Appalachian mountains; timber-wildlife habitat relationships in loblolly pine stands of the Piedmont; the impact of beaver on Piedmont forests; and impacts of recreation on vegetation. The National Wild Turkey Federation continues to support research on wild turkeys. Two other grants were funded in this area:

- o Economic analysis of increased regeneration through intensive harvesting. \$12,000. USDA Forest Service.

- o Dynamics of harvesting for the Mt. Holly plantation deer herd. \$92,000. Alumax Corp.

Research in this area resulted in various publications, among them: a generalized sustained yield table for whitetailed deer; geographical distribution of Oglethorpe oak -- a threatened plant species; and estimation of land area using optimum dot-grid density with aerial photographs.

Wood utilization research continued to grow with the addition of a new faculty member in forest products marketing who will develop more efficient and profitable ways of selling forest products. Progress continues to be made in the wood chemistry area as work continues on research on wood plasticization and surface characterization of weathered wood. Research was completed on water soluble cellulose-nitrate, a unique new product that was successfully synthesized. The sponsoring company currently is preparing a patent application.

The project leader recently returned from Japan on the second year of a two-year travel grant from the National Science Foundation to share information with Japanese researchers on advances in wood plasticization. Also during the year, as a result of an earlier trip to China by the project leader, the department head and the dean of the college, a memorandum of understanding was drawn up between Clemson University and the Beijing Forestry University to support joint efforts in faculty and graduate student research. One graduate student from China presently is pursuing his Ph.D. at Clemson under this agreement.

Grants funded over the past year are as follows:

- o Effect of weathering on hardwood's surface quality. \$88,000. Masonite Corp.

- o Selected physical and anatomical properties of wood produced by southern yellow pine fertilized with sewage effluents. \$19,277. DuPont Corp.

- o Wood energy guide for South Carolina. \$4,642. South Carolina Energy Office.

Among the publications in this area were: effect of cement/wood ratio on bending properties of cement-bonded southern pine excelsior board; strength and related properties of Oglethorpe oak; properties of white pine lumber dried by radio-frequency/vacuum process and conventional kiln process; protection of wood surfaces against photo-oxidation; fuel value of stems and branches in post oak and red maple; and bending and thermal insulation properties of cement-bonded cypress excelsior board.

Five of the department's faculty are located in the South Carolina Coastal Plain either at the Belle W. Baruch Forest Science Institute near Georgetown or the Forest Sciences Laboratory in Charleston. Their field of interest is biological productivity, and they have 12 state or McIntire-Stennis projects under way.

Major projects ongoing along the coast include: evaluation of randomness of pollination and potential for inbreeding in southern pine seed orchards; inbreeding depression in selected populations of loblolly pine; hydrologic monitoring of the Habcaw Barony; and the ecology of the fox squirrel in South Carolina.



Over the year, the National Science Foundation continued support for a study that monitors the input of nutrients back and forth from forest to salt marsh. Westvaco Corporation is supporting a project concerning the effects of harvest, site preparation and planting on pools of nitrogen and phosphorous in the loblolly pine ecosystem.

Publications from this group gave information on numerous topics, including: diurnal habitat characteristics of woodcock wintering in coastal South Carolina; methods of increasing early establishment of desirable timber species in the Santee River Swamp; an evaluation of seven years of spotlight count data on a coastal South Carolina plantation; and the compatibility of even-aged timber management and red-cockaded woodpecker conservation.

### Extension

A new effort for Extension Forestry is assuming responsibility for the certification of forest tree seed. During this first year, efforts have centered on establishing field procedures for certification and working with existing certified orchards to meet certification standards. Two new efforts also are being started -- the development of regional seed tree standards and a certified tree seedling program.

Clemson Extension continues to contract successfully with the U.S. Forest Service for regional and national workshops. Foresters from throughout the South spent six weeks at an intensive timber sales and harvesting workshop where computer modeling is used extensively. Another effort is with the silviculture certification program the Forest Service requires for their personnel. Land managers have to demonstrate their proficiency in effective management of a variety of difficult situations. Successful completion of the classroom and field work leads to certification of a manager's proficiency.

The availability of federal funds through the Renewable Resources Extension Act has permitted Extension to hire three area county Extension agents in forestry. The integrating of forestry agents into the field offices has led to dramatic increases in forestry educational efforts at the local level. Landowners, professional foresters and others have heralded this move as one of the best steps Extension has taken. Although federal funds were provided to test this new educational effort, continued funding will have to be state appropriated. Extension would like to expand this effort from 13 counties to the entire state.

### COLLEGE OF LIBERAL ARTS

It has been said that no university will ever become a great institution of higher learning without a strong program in the humanities and social sciences. The College of Liberal Arts recognizes the validity of this observation. It subscribes to the notion that a self-governing society requires of its citizens a basic and

general education that will enable them, regardless of their occupations or professions, to lead full and useful lives and to contribute to the general welfare of society.

Although only 9 percent of the undergraduate student body at Clemson University major in the liberal arts, the faculty of the college teach nearly one-third of the credit hours taken by students, and the college offers a number of the courses that constitute the general education requirements of the University.

The college is composed of the departments of English, History, Languages, Music, Political Science, Psychology and Sociology. With the exception of music, all departments offer major programs leading to the Bachelor of Arts degree, and English and history offer programs leading to the Master of Arts degree.

Eighty percent of the Liberal Arts faculty hold the doctoral degree or other terminal degree. Graduates of the college enter some of the country's outstanding graduate and professional schools, and many find work upon graduation or shortly thereafter in business or government, for example.

### Public Service

The college's public service role throughout the state and region continues to grow. Faculty members in political science are frequently called upon by local and state government or business and industry for advice on such problems as poll-taking, tax matters and governmental organization. Sociologists contribute their expertise on such topics as design and analysis of social surveys; the impact of industrial development on society; organizational functioning and leadership training; and program development and evaluation in the fields of prison reform, spouse abuse, mental health and alcohol and drug problems. Psychologists provide clinical service to Clemson's Redfern Health Center; management training for area industries and hospitals; consultation on jury selection, eyewitness validation and expert witnesses on criminal sanity; survey studies for local and state agencies; and a weekly newspaper column on labor-management relations. Members of the English faculty work with industry by conducting seminars and workshops in business and technical writing.

The Department of Languages continues to emphasize a practical, business orientation by encouraging Clemson undergraduates to major or minor in a modern language while preparing themselves for careers in business, engineering, computer science or textile science. Given the large foreign investment in South Carolina industry and the need to develop overseas trade markets, this is an important career option for Clemson students. The department also sponsors an annual Language Declamation Contest, which draws hundreds of participants from South Carolina and nearby states. In addition, the department conducted 1986 summer foreign-study programs in France, Germany and Spain. An outstanding recognition of Clemson's language students came this spring when the national Fulbright Award Committee selected two students for a year's scholarship to study abroad, one to France and one to Germany.



Among the recipients of the college's public service endeavors are the state's schoolteachers. Improved civic education in the state's public schools is the goal of the Thurmond Seminar, conducted by the Department of Political Science with funds from the Strom Thurmond Institute for Government and Public Affairs. Seventeen social science teachers from South Carolina's secondary schools participated in this summer's seminar, with classes held both in Clemson and in Washington. As part of the Educational Improvement Act, summer institutes were conducted on campus for Advanced Placement teachers in American history, English, European history, French, German and Spanish. The Department of History also helped 14 Piedmont-area social studies teachers prepare for the observance of the Bicentennial of the U. S. Constitution. Twenty-four Piedmont-area teachers interested in the teaching of writing attended the fourth six-week summer institute of the Clemson Writing Project sponsored by the Department of English and the College of Education. In addition, each fall the Department of English hosts the well-known and widely attended Children's Literature Symposium for the state's librarians and teachers. A faculty member in the department is president of the national association.

Members of the faculty serve regularly as program leaders for the South Carolina Committee for the Humanities and again this spring helped organize, conduct and contribute to the Piedmont Humanities Scholars Forum. Faculty in the Department of Music act as performers and judges in the state and region.

The College of Liberal Arts serves the student body in a variety of ways. For example, the Model United Nations Program, which is sponsored by the Department of Political Science and involves students from throughout the University, competes annually at such sites as Boston, New York and Washington. The State Student Legislature, which holds its annual competition in Columbia, and the government internship program, which involves students participating in local, state and national government, also are sponsored by the Department of Political Science and attracts students from throughout the University. Another example is the developmental course designed by the Department of English for freshmen with poor verbal skills. In addition, the Department of English operates a writing laboratory for any student with writing deficiencies. As an aid to foreign students, the department offers a course in English as a second language.

The college also contributes to University life by sponsoring a large number of student organizations and extracurricular activities. For example, the Department of English sponsors the Clemson Players, the student drama group that presents four plays during the academic year and two during summer school. In recent years, these productions have received regional and national attention. This year a grant from the South Carolina Arts Commission supported the production of A Killing Frost, an original play authored by a former Clemson undergraduate. The Department of English also provides faculty advisers for debate activities and for student publications, including The Tiger, The Chronicle and The Calhoun Literary Review. The Department of Music sponsors and manages the University Concert Series, the Chamber Music Series (beginning in the fall, this series

will be entitled "The Lillian and Bob Utsey Chamber Music Series"), summer school concerts and student musical organizations, including Tiger Band, the symphonic band, the University Chorus, the Four-Thirty Thursday Singers and the jazz ensemble. In addition, the Gospel Choir is sponsored by the Department of History.

The state's elementary and secondary school students make up another constituency served by the public service functions of the college. In conjunction with the College of Engineering and the College of Sciences, the Department of Psychology runs a series of summer science camps for gifted junior high and high school age youth. The Department of Languages offers instruction in French, German and Spanish to area elementary school students and initiated this year a two-week summer camp for high school students interested in enhancing their competency in French, German, Russian and Spanish. The Department of History annually presents "History Day" for pre-college students in the Third Congressional District.

### Faculty Highlights

Three highly respected journals emanate from the College of Liberal Arts. The South Carolina Review is edited and published by faculty members in the Department of English. This distinguished magazine provides a forum for literary scholarship and criticism as well as for outstanding poetry and short stories. The Journal of Political Science, with an international editorial board under the leadership of a faculty member in the Department of Political Science, boasts a list of authors from leading U.S. and international universities and colleges. This journal emphasizes contributions of younger researchers. The Department of Languages edits and publishes The Comparatist, devoted to the literary and language interests of scholars in the Southeast.

In addition to editing and publishing these journals, liberal arts faculty members continue to produce scholarly and creative work. They deliver papers at numerous regional, national and international meetings and conferences; they contribute articles, as well as poetry and fiction, to a variety of established and influential journals; they edit book-length collections and prepare textbooks; and they write books that are published by respected publishers and that are met with favorable reviews.

Other departmental activities include, but are not limited to: a syndicated book review column originating in the Department of History and published in newspapers across the country; a book review service originating in the Department of English that specializes in children's books; research conducted by faculty members in the Department of Psychology on a variety of topics such as aging, laterality of brain function, stress management, computer-assisted instruction and artificial intelligence; and research conducted by the faculty members in the Department of Sociology in several areas, including the prison system, parental grief, children's responses to crises, parental abuse, alcohol consumption and abortion.

Regular features of the College of Liberal Arts include gath-



erings of scholars and creative writers. For example, the college often conducts programs in cooperation with The Strom Thurmond Institute of Government and Public Affairs. Other annual events include observance of Black History Month and Women's History Week. This year the college began the Women's Studies Colloquia, which included monthly lectures and/or discussions on timely topics. One especially successful lecture series was entitled The Huguenot Connection; another noteworthy event was The Broadcasting, Politics and Society and Symposium.

A highlight of the year was the college's selection to receive a Challenge Grant by the National Endowment for the Humanities (NEH). Of the 248 nationwide applications, the college proposal was among 41 funded, and it was the only one funded in South Carolina. The Challenge Grant has resulted in the establishment of an endowment entitled "The Humanities and Cultural Literacy" and will provide up to \$300,000 in NEH matching funds to the humanities at Clemson during the next three years. For every three dollars in new gifts to the humanities at Clemson, the NEH will contribute one dollar, generating a total of \$1,200,000. The interest income from this endowment will support three essential projects: acquisition of library resources, faculty development and enrichment of the cultural life on campus.

#### COLLEGE OF NURSING

Clemson University College of Nursing offers academic programs leading to a Bachelor of Science degree and a Master of Science degree as well as a Continuing Education Program and a Nursing Center. The Bachelor of Science degree program prepares students for beginning practice as professional nurses while the master's degree program prepares students for specialized practice in family health nursing. The Continuing Education Program is directed primarily toward nurses who need to update their knowledge and skills of nursing practice. The Nursing Center is a clinical laboratory through which College of Nursing faculty and students provide skilled nursing services for clients who come to the Center.

Long-range planning for the College of Nursing includes the following goals:

- o Emphasize and strengthen the unifying community focus to guide curricula, research and service.
- o Develop and employ strategies to maximize and maintain enrollment and retention of highly qualified students.
- o Develop nursing strategies to identify and address health needs in the community, state, nation and world.
- o Generate a broad base of financial support for College of Nursing teaching, research and service.

Program administrators are working with faculty and/or advisory committees to develop subgoals under each goal, a time frame for goal attainment, tactics and strategies appropriate for achievement of goals and a method of evaluating progress.

In an effort to attain a level of excellence in all programs and activities, the college evaluated its existing organizational structure through both external and internal reviews. As a result, a new structure has been formulated and recommended to the Board of Trustees.

The proposed structure unites the graduate and undergraduate faculties into one faculty and combines the Nursing Center and Continuing Education Department in one professional services unit. This proposed new structure should facilitate long-term excellence of the college, expedite achievement of short- and long-term college goals, maximize contributions of faculty and staff and be cost effective. The reorganization should be operational within the 1986-87 academic year.

### Faculty

An increase in the number of doctorally prepared faculty is a major College of Nursing accomplishment. In fall 1982 seven (19 percent) of nursing faculty members were doctorally prepared. In fall 1985, 14 (34 percent) nursing faculty members had doctoral preparation. Additionally, during the 1985-86 academic year, four faculty members completed doctoral study. This increase in doctorally prepared faculty has helped to bring about the major accomplishments described below.

During the 1985-86 academic year, College of Nursing faculty agreed to conduct a rigorous review every five years of each tenured faculty member. This action is to be implemented in the 1986-87 academic year.

The College of Nursing received \$534,586 in outside grants, contracts and gifts during the 1985-86 fiscal year. This included a \$10,000 grant from the Helene Fuld Foundation to augment computer software available for undergraduate students in the Nursing Resources Laboratory and a continuation grant of \$140,319 from the Department of Health and Human Resources for enrollment expansion in the graduate program. Of particular note is the gift of computer hardware and software from the NCR Corporation. The new NCR equipment has enabled the College of Nursing to set up a computer laboratory for students and to provide personal computer facilities for faculty.

The School Nurse Practitioner Project is a major new College of Nursing effort funded by the Department of Health and Human Services, Public Health Service, Division of Nursing. The grant award for the first of three years of this program is \$158,085. This project is directed toward preparing school nurses to provide comprehensive health assessments and health guidance for school-age children. In South Carolina, school nurses are often the only health professional with whom school children come in contact. However, large numbers of school nurses have not learned to do health assessments.

In the area of research, College of Nursing faculty were assisted this academic year by Margie N. Johnson, R.N., Ph.D., professor of nursing, Texas Woman's University, Denton, Tex. Dr. Johnson was the University's first Distinguished Scholar in Residence. During her appointment, she helped increase significantly the number of faculty



members engaged in research. Additionally, under Dr. Johnson's leadership, funding for faculty research increased. For example, during spring semester 1986, 16 faculty members received research support. Two of these faculty members had outside support; remaining support was internal.

### Instruction

The faculty has developed a plan for advanced placement of registered nurses in the undergraduate program; integrated flexibility options in the graduate program; and an accelerated education path from undergraduate through graduate programs for academically exceptional students. Additional honors courses have been developed and will be available to students during the coming academic year.

The demand for nurses within the public sector is again intensifying. The American Nurses' Association predicts that by the year 2000, only half the needed number of baccalaureate-prepared nurses will be available to employers. In an effort to maintain and increase enrollment in both graduate and undergraduate programs, the college has undertaken an intensive student recruitment program. Faculty development, curricular evaluation, new student services and recruitment activities are aimed to meet this end.

### Continuing Education

Continuing Education activities this academic year generated more than \$301,000 in revenues as a result of fees collected from South Carolina participants, as well as from individuals living in 30 additional states, who enrolled in short courses and seminars coordinated by the continuing education department. This year the accreditation of the continuing education program by the American Nurses' Association was extended until February 1990, the maximum period for which accreditation is awarded. Additionally, this accrediting agency commended the department for efforts to ensure a high quality program.

### Nursing Center

Client visits to the Nursing Center and revenues generated have increased significantly this year. Provost David Maxwell has recommended that the University wellness coordinator position be placed within the Nursing Center. With this position in place, it seems likely that the Nursing Center will be strengthened as a clinical laboratory for students of nursing and as a research site for students and faculty.

## COLLEGE OF SCIENCES

The College of Sciences attracts a gradually increasing number of majors because of continuing student interest in the areas of pre-professional health, environmental concerns, energy-related problems and computer science.

The college continues to be responsible for 30 percent of the total University teaching load due to the high percentage of undergraduates majoring in engineering and other technically related subjects.

Although availability of external funds for research support is still declining on a national basis, the faculty of the College of Sciences once again increased its share of those funds during the 1985-86 fiscal year, with the total value of all grants and contracts in force exceeding \$8 million -- more than double the amount received five years ago. Notably, this ratio of externally generated grant and contract funds to the state funds expended to attract this support continues to be the highest in the University, that ratio being 3.75:1 for 1985-86.

The Department of Mathematical Sciences was awarded a \$3.2 million contract by the Office of Naval Research under the Department of Defense University Research Initiative program. This is a major effort by DOD to support fundamental academic research in areas that may be of importance to future national security. Only 25 proposals were selected for funding under this program. Of the 357 submitted, the Clemson proposal was one of only three funded in mathematics.

On June 30 the Department of Chemistry and Geology ended a long association when the geology portion became the Department of Earth Science. The Department of Chemistry is anticipating a move this fall across campus to its new building.

### Biology Program

During the 1985-86 academic year, approximately 4,500 students were enrolled in courses offered by the Biology Program. Seven lecture sections and 56 laboratory sections per week were taught by faculty and graduate students from the Biology Program and departments of Microbiology and Biological Sciences.

The Science Learning Resources Center, which houses both audio-visual and microcomputer materials, was used successfully by several lecture and laboratory sections of students. Using the computer-based Teacher Information Processing System (TIPS), it is possible to pair individual students with audio-visual and computer materials appropriate for their level of ability and mastery of the subject matter being taught. A year-long experiment comparing TIPS users with non-users was conducted by the faculty, and data indicated that most students were able to improve their grades by using TIPS and the Learning Resources Center.

The Seventh Clemson University Biology Merit exam was conducted for more than 1,700 high school and junior high school students. Top



winners were awarded scholarships to Summer Science Camp through a grant from the Alumni Foundation Fund. The faculty continued its involvement with teacher education in South Carolina, offering two science courses for elementary teachers, a summer institute program for middle school life science teachers and high school biology teachers. The faculty presented laboratory exercise workshops at the South Carolina Science Council meeting and distributed laboratory packets to South Carolina teachers.

Notable faculty activities included renewal of a \$2.2 million National Science Foundation grant in conjunction with the University of South Carolina and the Charleston Consortium. The grant is a three-year program in teacher education in the areas of science and mathematics. A second faculty member continued work on a \$184,000 grant from the National Science Foundation to develop computer software in biology. A grant from IBM for the evaluation of biology software was submitted and funded. One faculty member served as director of the Junior Academy of Sciences for South Carolina, and another was appointed chief reader designate for Advanced Placement Biology with the Educational Testing Service. The premedical adviser, also a faculty member in the Biology Program, was appointed three-year director of the Southern Association of Advisers to the Health Professions and was nominated for a position on the president's advisory board for the Medical University of South Carolina.

Additional activities included presentation of six papers at annual meetings of the National Science Teachers Association and National Association of Biology Teachers; organization and direction of the Junior Academy of Science Winter Workshop and Science Olympics; judging the South Carolina Junior Academy paper presentations; and judging the western regional science fair and other state science fairs.

Three manuscripts were published, and four laboratory manuals were revised and published. One new laboratory manual was published through a national firm. Four grant proposals were submitted and are pending.

#### Department of Biological Sciences

In fall 1985 the Department of Biological Sciences had 172 students enrolled in undergraduate degree programs (76 in biochemistry and 96 in zoology). There were 31 M.S. students (four in biochemistry, eight in botany and 19 in zoology) and 41 Ph.D. students (three in biochemistry, three in botany enrolled under the program in plant physiology in the College of Agricultural Sciences and 35 in zoology). The doctoral program in zoology continues to serve the largest group of Ph.D. students at Clemson. During the 1984-85 academic year, the department awarded 35 B.S. degrees (13 in biochemistry, four in botany and 18 in zoology), nine M.S. degrees (one in biochemistry, two in botany and six in zoology) and seven Ph.D. degrees (one in plant physiology and one in zoology).

Research and training activities were supported by 22 grants and contracts: five from the National Science Foundation; four from the U.S. Army Corps of Engineers; two each from E.I. DuPont de Nemours &

Co., the Water Resources Research Institute and the National Institutes of Health; and one each from the Electric Power Research Institute, the U.S. Forest Service, the U.S. Army Medical Research program, the American Heart Association, the U.S. Air Force Office of Scientific Research, Pioneer Hibred International and the South Carolina Sea Grant Consortium. Several faculty members and their students were awarded seed-time for use of the Electron Microscope Facility, and one faculty member was awarded a Provost's Award for his scholarship. Another received a grant from the National Geographic Society.

Scholarly activities by faculty and students during the year included papers presented at three international meetings and more than 46 papers delivered to national and regional meetings of scientific or professional societies. Thirty-eight scientific papers, three book chapters, and a number of abstracts, reviews or notes were published or are in press. The biological sciences faculty includes one Rhodes and one Danforth Scholar and two Fellows in the Explorers Society.

Professional and service contributions by members of the faculty included the following activities: chairman, Heritage Trust Advisory Board of South Carolina; first president elect, Animal Behavior Society; Board of Scientific Advisers (two faculty members, one serving as chairman) and Board of Trustees and member of the executive committee of the board of Highlands Biological Station; Board of Governors of the South Carolina Aquatic Plant Management Society; member of the University, State and District Selection Committees for the Rhodes Scholarship Trust; associate editors for the Transactions of the American Microscopical Society, the Journal of Experimental Zoology and the Journal of Environmental Biology of Fishes; and technical editor of the Journal of the American Killifish Association. Lawrence A. Dyck is president of the Faculty Senate, and a number of our faculty members served on commissions and other university, college and departmental committees.

Faculty members of the department gave seminars at several other institutions. Our doctoral graduates all presented dissertation seminars as a part of their defense. Outside speakers also visited our campus to present seminars. A number of informal presentations were made as part of our Brown-bag Seminar series by faculty and students. Seminars are an integral part of our training program and serve to acquaint others with our facilities and activities while promoting the exchange of information and ideas.

The vertebrate museum and herbarium continue to support our teaching, research and service roles. The Field Station is used in a number of training and research activities, and the Greenhouse and Animal Room Facility are important to our integrated program.

During the year, the faculty approved an industrial biology option as part of our B.S. curriculum in the biological sciences and is actively seeking industry support for this program. Plans have been developed for integrating our teaching and research programs in the area of modern cell and molecular biology (biotechnology) and in the field of environmental science, along with faculty in other departments and colleges, as a part of the University's Second Century plan. The department remains committed to the education of under-



graduates and graduates, an active and relevant research program, and service to the profession and state.

#### Department of Chemistry and Geology

A milestone was reached this year with final approval by the Clemson University Board of Trustees to separate chemistry and geology into two departments. Effective July 1, 1986, the geology component became the Department of Earth Science. Chemistry and Geology had functioned as a combined department essentially from the funding date of Clemson University. The separation will allow both groups to progress more rapidly.

Completion of the new chemistry building encountered some delays, with occupancy planned for fall '86 instead of summer. The building will be a tremendous boost to teaching and research in chemistry. Significant new funds for the purchase of teaching and research equipment for the new building did not materialize due to increased costs for completing the building and budgetary limitations.

Kenneth Marcus was hired as an assistant professor of analytical chemistry. He received his Ph.D. from the University of Virginia and is an expert in the application of mass spectrometry to the analysis of gas plasmas. A major instrument company has donated a sophisticated mass spectrometer system to the department in support of his research program. Dr. Marcus will greatly strengthen the teaching and research programs in analytical chemistry.

Twenty B.A. and B.S. degrees were awarded in fiscal year 85-86, a significant increase over 84-85. Lisa Marie Schwartz, a B.A. graduate in chemistry, received the 1986 Norris Medal at the May commencement as the best all-around graduating student.

Graduate degrees in fiscal 85-86 numbered only two M.S. and one Ph.D. in chemistry. This low number contrasts with increased graduate enrollments in chemistry, which will reach a 15-year high at 60 this fall. The low number is an aberration that will be offset by an unusually large number of advanced degrees in 86-87. Graduate recruitment in 85-86 was the most successful in recent years, reflecting the growing stature of the chemistry graduate program.

Faculty achieved many distinctions during the year, including the largest number of scientific papers presented by a single department at the 1985 joint Southeast-Southwest Regional American Chemical Society Meeting held in Memphis, Tenn., in November 1985. Dr. Gregory H. Robinson, the department's first black faculty member, received a large grant from the National Science Foundation in his first year on the faculty. Other faculty received research support from non-state sources ranking the department number one in this important area in the College of Sciences. Dr. John D. Petersen, professor and associate dean, received a prestigious Alexander von Humboldt Research Fellowship for study and research in West Germany.

A discovery by Department Head Dr. Darryl D. DesMarteau concerning a new method for selective fluorination of organic compounds has generated considerable international interest.

## Department of Computer Sciences

The Department of Computer Science completed another successful year of growth and progress.

The number of majors remained at about 500 undergraduates and 86 graduate students. Enrollment is likely to decrease slightly following a national trend. The department had 105 B.S. graduates and 14 M.S. graduates during the year. The demand for our graduates by employers remains strong.

Externally funded research remains at a level of about \$1 million annually. Faculty members remain active in publications and other scholarly and professional activities.

Space continues to be a serious problem for the department. Several substantial equipment donations have been obtained, but the most recent of these are not being used because no space exists in which to house the equipment. The situation will be improved somewhat during the coming year when newly renovated space in Jordan Hall becomes available, but still will remain critical and will continue to inhibit the department's growth and activities.

Faculty recruiting continues to be difficult. Although the department was successful in filling two of its vacancies during the past year, one vacant position remains unfilled, and the department continues to be substantially understaffed.

## Department of Earth Science

The Department of Earth Science was established on July 1, 1986, by separation of the Geology Program from the Department of Chemistry and Geology. During the 1985-86 academic year, while still part of the Department of Chemistry and Geology, the Geology Program had 23 undergraduate majors. Nine students received B.S. degrees in geology, and one geology B.A. degree was awarded. Overall enrollment in geology courses for the year was 507 students.

The Geology Program has been actively involved with science teachers' education in South Carolina. During summer school 1985, two courses in geology for middle school teachers were offered. In the spring 1986 semester, a geology faculty member taught an education course for elementary school teachers, directed a workshop of the South Carolina Science Council and led a field trip for the South Carolina Earth Science Teachers Association.

Faculty in the Geology Program were productive in research during 1985-86. Two faculty members received grants from the University Research Grant Committee; one received a Provost Award; another was awarded seed-time money for use of the Electron Microscope Facility. In addition, outside research funding was obtained from the following sources: Water Resources Research Institute/South Carolina Water Resources Commission; South Carolina Geological Survey; North Carolina Department of Agriculture and W.K. Kellogg Foundation.

Five refereed manuscripts were published in scientific journals, and one chapter in a laboratory manual was published. One faculty member presented an invited talk at the regional Geological Society of



America meeting, and a second was invited to present a talk at the Institute for Geology in Innsbruck, Austria. A third faculty member was interviewed by WNSC-TV because of his expertise in Piedmont groundwater geology.

Other activities of geology faculty in 1985-86 included mapping for the South Carolina Geological Survey; representing Clemson University on the South Carolina State Mapping Advisory Committee; participation on a statewide committee reviewing teachers' certification requirements for earth science; judging at the Anderson District state fair; state coordinator for the National Association of Geology teachers; and presentation of talks at local schools.

#### Department of Mathematical Sciences

During 1985-86, 52 mathematical sciences majors received baccalaureate degrees, 16 received master's degrees and eight received doctoral degrees.

Two members of the faculty, Dr. J.L. Flatt and Ms. K.R. Watson, retired during the year and were replaced by new faculty, one of whom joins at the associate professor rank.

In June Dr. T.G. Proctor was named associate head of the department. He succeeds Dr. R.D. Ringeisen, who has chosen to return to full-time faculty duties.

Several members of the faculty have distinguished themselves during the year. One delivered the 1985 Johns Hopkins Lecture Series in the Mathematical Sciences, was Landsdowne Visiting Scholar at the University of Victoria, and was named managing editor of the Journal of Algebraic and Discrete Methods of the Society of Industrial Applied Mathematics (SIAM). Another, who was named a University Alumni Professor this year, serves as chair of the Academic Affairs Committee and the Mathematical Sciences Advisory Committee of the College Board, and also as governor of the Southeastern Section of the Mathematical Association of America. Another faculty member won the Frank Wilcoxon Prize for the year for the best practical application paper in the journal Technometrics. Another, while on Intergovernmental Personnel Act leave, served as acting head of the Mathematics Division of the Office of Naval Research.

Last year, with the department of Elementary and Secondary Education, the department participated in a Center of Excellence Grant in Mathematics Education funded by the South Carolina Commission on Higher Education. The department also is a participant in the National Science Foundation Grant to South Carolina, "The South Carolina Cooperative Plan for the Professional Development of Science and Mathematics Teachers in Grades 7 - 12."

The discrete mathematics faculty concluded activities in the final year of their five-year NSF, EPSCOR Grant. This grant enabled the discrete mathematics faculty to achieve national prominence. During May 13 - 16, 1986, the department and the University hosted the third SIAM Discrete Mathematics Conference. Previous meetings of this conference had been at the Massachusetts Institute of Technology and the Rennselaer Polytechnic Institute.

On June 26, 1986, Secretary of Defense Caspar Weinberger announced that a proposal from the department was one of 70 nationwide and one of only six in mathematics funded in the University Research Initiative Program of the Department of Defense. On September 15, 1986, faculty of the department will begin a five-year, \$3.2 million research contract with the Office of Naval Research.

### Medical Technology Program

The Medical Technology Program completed another productive year of advising, teaching, administrative activity and club sponsorship.

Nine entering freshmen and nine transfer or change-of-major students joined the medical technology curriculum. This was balanced by 18 students changing out of the program to other fields. In addition, four students completed the baccalaureate degree requirements for graduation. Approximately 40 students are enrolled in the program. Our senior clinical-year students continue to excel on the national certification exam, and all have been successful in finding employment in the field.

The senior-year clinical courses continue to be offered by hospital program affiliates and other nonaffiliated schools. Active affiliate programs are at the schools of Medical Technology at Anderson Memorial Hospital in Anderson, S.C., and at McLeod Regional Medical Center in Florence, S.C. This year all successful senior students remaining within our affiliate network chose to attend the nearby Anderson Hospital program. The Anderson program also continues to help teach the introductory medical technology course taken by new majors.

With the recent advent of government restrictions limiting health-care reimbursements, many hospital-based programs in health education need to develop additional sources of funding to survive. Through the Medical Technology Committee, the University is developing a plan to begin in the 1987-88 year whereby Clemson University will provide a significant amount of support to the Anderson Hospital School of Medical Technology for each Clemson clinical student in attendance there.

The current program coordinator continued to promote medical technology by group and individual presentations to students from around the state and by participation in the annual meetings of the S.C. Society for Medical Technology and of the American Society for Medical Technology.

The Medical Technology Club completed another successful year of activities including trips to an area hospital lab and to the State Department of Health and Environmental Control lab in Columbia, presentations by speakers, service projects and attendance by several students at the SCSMT meetings.

### Department of Microbiology

Research and teaching programs continued to develop during this year. There were 120 students enrolled in the B.S. curriculum and 36



in graduate programs; 14 of the latter were pursuing the Ph.D. degree and 22 were in the M.S. program. During the year, 34 undergraduate majors were named to the Dean's List, and 10 were recognized on the President's List. Twenty-six students received the B.S. degree and continued with careers in a variety of industries, entered graduate degree programs, or began professional studies in medicine or dentistry. For the first time, one of our graduates was admitted to the medical school of Duke University.

The undergraduate Microbiology Club, which was the first undergraduate organization in the nation to be affiliated with the American Society for Microbiology (ASM), operated an active program. They participated in a regional meeting of the ASM and Science Day and hosted several professional events on campus.

The faculty actively sought external funding to support research. Some 20 proposals were submitted. Funds were obtained from the Army Research Office, Sea Grant, ERCD, USDA, DaVinci Corporation and private donations. A variety of both basic and applied research projects were undertaken, many involving biotechnology. Many projects were cooperative efforts with other academic departments, e.g. Agronomy and Soils, Aquaculture, Fisheries and Wildlife, Food Science, Plant Pathology and Physiology, and Poultry Science.

Major research areas pursued include: microbial decontamination of commercially imported shellfish; basic properties of a nitrogen-fixing bacterium found associated with marine grasses; the effects of chemical pollutants on microbial processes in aquatic sediment; immunologic aspects of fish; development of a monoclonal antibody assay for mycoplasma bacteria; the cellular mechanism of immunomodulation by the chemical dimethyl glycine; molecular control of cellulose degrading enzymes of potential commercial importance; characteristics of microbial enzymes that attack pectin; properties of an immune factor degrading enzyme produced by a bacterium that causes respiratory infections; degradation of processed alfalfa to sugars for ethanol production as a fuel supply; molecular genetics of nitrogen-fixing bacteria associated with soybeans; molecular genetics of pectinolytic enzymes of nitrogen-fixing bacteria.

Also: development of genetic systems for lactic acid producing bacterial important in food fermentation industries; degradation studies and persistence of herbicides used for aquatic weed control; biogenesis of methane gas; model ecological studies with salt marsh bacteria; microbial aspects of cotton dust as related to brown lung disease; genetic and physiological optimization of amino acids produced by a bacterium for commercial use; hormonal effects on DNA functions in mammalian cells; studies on molecular aspects of cancer; evaluation on human cells with respect to sensitivity to ultraviolet radiation damage; effects of chemical carcinogens on DNA; molecular biology of bacterial viruses; and development of a clinical diagnostic assay for use with cancer patients undergoing chemotherapy.

Professional activity of faculty have included presentation of papers at national and international meetings of societies; delivery of invited seminars at various universities and industrial concerns; and publication of research findings in international scientific journals. Two faculty organized a symposium on microbial aspects of chemical

pollution for a regional ASM meeting. Faculty have routinely served as reviewers of research proposals for federal granting agencies and of papers for professional journals. One faculty member served on two site visit teams for NIH. Several have served as consultants for a number of industrial companies. One faculty member spent a sabbatical leave at the medical school of the University of Birmingham, England, where he investigated bacterial aspects of arthritis.

#### Department of Physics and Astronomy

The most significant teaching-area accomplishment in the Department of Physics and Astronomy this year was the graduation of our best senior class. All eight graduated with senior division honors, two with perfect 4.0 GPRs, and all are going to graduate school under fellowships or assistantships or studying abroad under Fulbright fellowships. In addition, one of these students, Wendy Schaffer, was recognized by the University as the Outstanding Undergraduate Woman for 1985-86.

In April the department conducted its most successful Physics Day (in cooperation with the Clemson Area Amateur Astronomers), with more than 500 high school students coming to learn about our program and careers in physics and astronomy.

Professor W.E. Gettys received an award from the University as an Outstanding Honors Teacher. He also was awarded a grant by the State Department of Education to sponsor an Advanced Placement Institute in Physics for two weeks during summer 1986. Another professor was invited by the American Physical Society to present a lecture at a national symposium on the physics of toys. Another teaching accomplishment was the continued development of undergraduate physics laboratories to include a greater number of experiments interfaced with microcomputers.

The department has achieved distinction in research through an outstanding program in atmospheric physics that continues to attract funding from several federal sources (AFOSR, NASA, NSF) and an increasing number of graduate students. In addition, the internationally recognized program in solid state physics has attracted new funding from Martin Marietta and Kodak. The department's growing and successful program in computational physics has attracted funding from the Research Corporation and NASA.

One of our faculty is a member of the Board of the Southeast Universities Research Association and was a leader in the development of the SURANET communications network. Collaborative work was conducted by many of our faculty with research institutions abroad and with national laboratories. One received a NASA Resident Research Associateship by the National Academy of Sciences.

The department administration changed in December with the appointment of C.W. Ulbrich as acting department head. He will serve in that position while the faculty searches for a new department head to replace P.B. Burt.



## GRADUATE SCHOOL

The administration of the Graduate School expanded during the 1985-86 academic year with the addition of Dr. DeWayne Brooks as assistant dean. His position with the Graduate School is presently one-half time. Dr. Brooks, who has been on the faculty for 14 years and holds the academic rank of associate professor of elementary and secondary education, brings to the Graduate School a wealth of administrative experience as former director of the Office of Educational Services.

Workshops and help sessions initiated by the Graduate School staff proved to be of significant benefit to students writing theses and dissertations. Plans are to make these activities permanent.

A new doctoral degree program in food technology was approved by the Commission on Higher Education for offering in 1986.

Enrollment for the 1985 fall semester was 2,451, including 152 enrolled in the Clemson-at-Furman MBA degree program. Total enrollment in graduate degree programs was 1,937, with 390 enrolled in doctoral programs, record numbers in each category.

Advanced degrees awarded during the year totaled 573, including 56 doctoral degrees.

Eighty-two students received fellowships, representing more than 7 percent of the 1,129 full-time graduate students eligible for such awards.

Graduate assistantships requiring service to the University were granted to 887 graduate students, or 79 percent of those eligible. More than one-third of these assistantships were supported by research funds, a record for the University.

## UNDERGRADUATE STUDIES

The Undergraduate Studies Office is responsible for undergraduate academic programs and curricula, academic standards, scholarships and awards, University-wide lectures, new faculty-staff orientation, summer sessions, the Clemson Career Workshops, the Honors Program and special graduate scholarship programs.

The Clemson Career Workshops bring academically outstanding minority students to campus before their junior and senior years in high school. The 1986 program included 322 students at both levels. Clemson expects 39 new freshmen recruited by this program to enroll in fall 1987.

The Honors Program enrolled 4 percent of the undergraduate student body in 1985-86, and 27 students were graduated with Senior Departmental Honors in December, May and August. Two Clemson seniors received Fulbright scholarships for foreign country study in 1986, bringing the number to 22 in the past seven years.

Undergraduate Studies is also responsible for planning the Clemson University Centennial. The celebration of that event will begin April 6, 1988.

## VICE PRESIDENT FOR ADMINISTRATION AND SECRETARY OF THE BOARD OF TRUSTEES

The position of vice president for administration was created on August 1, 1985, when Hugh J. Clausen assumed its duties and succeeded Joseph B. McDevitt as the secretary of the Board of Trustees.

The director of public safety, who supervises the police and fire departments, and the director of traffic and parking report to the vice president for administration. The University municipal judge relies on this vice president for administrative and logistical support. The internal auditor reports to the secretary of the Board of Trustees, who, in turn, reports directly to the chairman of the Board.

The Office of the Vice President for Administration and Secretary of the Board of Trustees is located in Sikes Hall. Expenditures for the fiscal year ending June 30, 1986, were \$2,212,599.00.

### Office Of Municipal Judge

The staff of the University municipal judge's office consists of the judge and an administrative specialist.

Formerly called the University recorder, the judge for the municipality of Clemson University makes decisions on all parking violations brought before the court; tries all persons charged with violations of ordinances passed by the Board of Trustees and all state laws that fall under the jurisdiction of the municipal judge or where the maximum penalty is a fine of no more than \$200 and/or 30 days imprisonment; and issues warrants for persons charged with high crimes and misdemeanors committed on campus. Expenditures for 1985-86 were \$20,341.

### Internal Auditing Division

The staff of the Internal Auditing Division of Clemson University consists of six members: a director, an audits manager, an EDP specialist, two staff auditors and an administrative assistant. The director reports administratively to the secretary of the Board of Trustees. Departmental expenditures for the year were \$195,626.

The division provides an on-going, independent audit function for the University as a service to management. Audit parameters include financial, compliance and operational review, as well as special requests.

### Department Of Parking And Vehicle Registration

The Department of Parking and Vehicle Registration maintains parking and traffic records that coincide with the academic calendar, from August 15 to August 15 each year. From August 15, 1985, through May 15, 1986, 10,803 student and 6,119 employee parking decals were issued, and \$20,455 was deposited to the miscellaneous income account. The Clemson University Police wrote 44,964 parking tickets. Parking fines collected by the Department of Parking and Vehicle Registration and deposited to the miscellaneous income account totaled \$95,575, while \$249,050 was transferred to the accounting office for collections. Of that amount, \$121,225 has been collected. The Student Traffic Review Board heard appeals from 1,811 students involving 2,218 parking tickets, or about 5 percent of the tickets written.



## Fire Department and Emergency Medical Service

During the 1985-86 fiscal year, the Clemson University Fire Department responded to 401 fire alarms and 236 medical alarms. Property damage from fires was \$269,000, none of which was state property.

In February, a five-year contract to provide suppression services to the City of Clemson was signed. As partial compensation for these services, the City purchased and will title to the University a new fire engine and equipment valued at \$192,650.

Paramedic services were initiated by the Fire Department, along with training standards established by the S.C. Fire Academy.

## Clemson University Police Department

The Clemson University Police Department provides services to maintain the security of persons and property on campus:

- o Crime prevention programs educate the campus community in methods to deter criminal activity and assist police.
- o Uniformed patrol officers move about campus to deter and detect activity and to preserve order.
- o Investigators assemble facts and evidence to document reported incidents, identify offenders and assist in the administration of justice.
- o Officers direct traffic to avoid congestion, maintain orderly operation and parking of vehicles, and investigate traffic accidents on campus.
- o Other services include monitoring intrusion alarms, transporting sick/injured students to the infirmary, and providing for parking and security at special campus events.

During 1985-86 the Police Department responded to 6,807 calls for service. Property losses due to criminal activity totaled \$98,249, 168 arrests were made and \$8,023 was recovered. Amounts returned to victims by offenders diverted to the Pre-Trial Intervention program have not been tabulated. Calls for service increased by 9.6 percent over last year. The overall crime rate reported at Clemson University compared favorably with that reported in Pickens County and at other S.C. academic institutions.

During the year the department's 31 sworn officers achieved 100 percent certification by the South Carolina Criminal Justice Academy. Patrolmen Greg Newton and James Gowan received the J.P. Strom award for having achieved the highest class score during basic training. Department personnel attended a variety of professional development training classes. Three officers were certified as instructors -- one each in defensive driving techniques, traffic radar operation and firearms proficiency training.

An additional crime prevention program was implemented to provide direct communication between a crime prevention specialist and University departments so that suggestions can be made and plans formulated to enhance security efforts and deter criminal activity. This program helps the Police Department serve the University community better and it helps individual departments strengthen their security efforts.

The Police Department acquired Pickens Bend Range and began modifications to the firing range, which, when completed, will provide a facility for firearms training for the Police Department, ROTC cadets, and local law enforcement and military organizations.

## OFFICE OF UNIVERSITY RESEARCH

The Office of University Research provides information and assistance concerning all aspects of the University research effort to faculty members, departments, colleges and other administrative units. The office helps prepare and submit applications for sponsored research, instruction and public service programs. During 1985-86 the office processed 716 faculty proposals.

The office also provides University liaison between the institution and all public and private, national and local organizations or entities concerned with any aspect of research support, regulation or administration.

Guidance and executive support were provided to the University Committee for the Protection of Human Subjects; the Biomedical Research Support Grant Committee; the University Research Grant Committee; the Committee for Laboratory Animal Welfare; the Institutional Biosafety Committee and the Clemson University Patent Committee.

## THE STROM THURMOND INSTITUTE OF GOVERNMENT AND PUBLIC AFFAIRS

The Strom Thurmond Institute is the main program component of The Strom Thurmond Center for Excellence in Government and Public Service, which comprises a planned institute and archives building, a multi-purpose auditorium facility and a continuing education building. The Thurmond Center is funded entirely by private contributions and will make possible an endowment to support the six programs of The Thurmond Institute:

- o The Thurmond Seminars in Government and Politics
- o The Strom and Nancy Thurmond High School Achievement Program
- o The Thurmond Scholars Program
- o The Institute Lecture Series
- o The Institute Distinguished Lecturers Program
- o The Institute Governmental Research Program

Since its inception in July 1982, the Institute has sponsored public programs featuring a number of leading opinion makers addressing such subjects as the proposed balanced budget amendment, nuclear arms freeze, terrorism, El Salvador, improvement of public education, farm and food policy, and civilian-military cooperation in defense research and engineering. Speakers featured have included Sen. and Mrs. Thurmond; Sen. Patrick Leahy, D-Vt.; Dr. Edward Teller; U.S. Rep. Michael Barnes, D-Md.; Dr. Helen Caldicott; Secretary of Commerce Malcolm Baldrige; Prime Minister Eugenia Charles of Dominica; Ted Turner; John Connally; Undersecretary of Defense Richard DeLauer; Admiral Hyman Rickover; Reverend Jesse Jackson; and members of the Clemson University faculty.

The Institute has on-going governmental research programs in state and local government, volunteerism and civic participation,



natural resources policy and defense studies. The Institute has a major research contract with the state of South Carolina to develop a long-range water policy for the state. The study involves six departments at Clemson University and two departments at the University of South Carolina.

The Institute publishes a lecture series, working papers on a variety of public subjects and proceedings of other programs it sponsors.

## CLEMSON UNIVERSITY LIBRARIES

This was a year of expanding services for the users of the Clemson University Libraries. New services were initiated in Cooper, Gunnin and Sirrine libraries. The implementation of the NOTIS circulation module was the automation highlight of the year, and the addition of more than 600 new periodical subscriptions was the collection highlight.

### Services

Three major new services were added to the Reference Unit in Cooper Library during the year. One of the most successful is "Do-It-Yourself Searching." Private funding allowed students and faculty free access to the many data bases of two major vendors during evening hours. Users are required to attend a one-hour training session. To make the system available to as many users as possible, each is limited to one 30-minute session each week, and reservations must be made a day in advance. From its beginning in mid-February until the end of the fiscal year, 424 individuals attended the training sessions, and 210 used the service one or more times.

With funding help from Blue Key, the Cooper Library was able to subscribe to the state-of-the-art information retrieval system marketed by InfoTract<sup>TM</sup>. In the Cooper Library, InfoTract<sup>TM</sup> operates on four IBM PCs connected to laser disks to provide rapid and easy access to bibliographic information on two data bases. These InfoTract<sup>TM</sup> data bases cover general periodical literature, business information and government publications. Other data bases can be added as they become available and as funding permits.

To address faculty's need for convenient, economical photocopying, Cooper Library installed a copier accountant on a new photocopy machine in the reference area and issued copier "credit" cards to faculty and departments. The cost per copy has been set at \$.04, a price competitive with departmental copiers. This system retains records of users and the number of copies made. These data are downloaded monthly into one of the MacIntosh microcomputers, and invoices for the various colleges and departments are produced. This new service has proved popular and cost effective.

The acquisition of a modem for the Apple MacIntosh in the Gunnin Architectural Library has allowed that library to access data bases

outside the libraries. Staff in Gunnin can now search the bibliographic records of art materials owned by the large university and museum libraries available on the Research Libraries Information Network.

With financial support from the College of Commerce and Industry, the Sirrine Library was able to subscribe to a two-station, one-data-base InfoTract<sup>TM</sup> system for use by Sirrine Hall students and faculty.

### Collections

With the increase in the libraries' materials budget from appropriations, summer school money and private funds, the libraries' collections were enriched by the addition of 677 new periodical subscriptions, the largest single-year increase in the libraries' history. This increase brings the subscription total for serials and periodicals to 7,057.

During the year, Clemson University Libraries worked with the library of the University of South Carolina and the State Library to develop an arrangement, which was accepted by the Superintendent of Documents Office, for a shared regional depository of U.S. government documents in South Carolina. This regional depository operation will be shared by Clemson University and the University of South Carolina libraries. Between these two libraries, all U.S. government documents available in the depository system will be available to South Carolinians. Furthermore, the Selective Depositories of South Carolina now will be able to discard documents they no longer need to keep. Without a regional depository in the state, selective depositories were not able to discard these materials.

Also during the year, an inspector with the U.S. Superintendent of Documents Office reviewed the libraries' collections and service. The library received the highest rating (excellent) in all but one category (staff size), for which we received a very good rating.

Several significant University record collections were acquired during the year, including copies of the University's budgets, files of the former dean of the College of Education, records of the YMCA, two collections of photographs and the papers of former President Bill Atchley.

Other manuscript collections acquired include additional papers of George Hartzog, Russell Dickenson and Sen. Benjamin Tillman. Several significant papers acquired earlier were processed or reprocessed during the year, including the papers of Ed Young, Ben Robertson, Ben Tillman and Paul Quattlebaum.

Processing of the Thurmond Collection shifted from implementing basic control to completion of processing on several series.

### Automation

During 1985-86 implementation of the acquisitions and serials control modules in NOTIS was completed. This had significant impact not only for the staff using them, but also for the users of LUIS.



With these two modules in place, the user now can see which books and journals are on order, or which issues of journals have arrived and been checked in.

A major project was the planning and implementation of the new NOTIS circulation module. Planning was managed by five task forces who worked throughout the year to implement this system.

In the spring, the entire staff barcoded the collections in Cooper, Gunnin and Sirrine libraries. The collection of the Gunnin Architectural Library was the first to be barcoded and was used to train the staff. The library officially implemented the circulation systems July 28, 1986.

### Records Management Program

The first full year of the records management program was successful. Procedures were developed, and work began with the records of the colleges of Liberal Arts and Commerce and Industry. During the year, additional offices were inventoried and scheduled, including the Office of Financial Management, Office of University Research, student housing, student health services, Office of Registration and Admissions and the Office of the President. More than 300 schedules representing more than 7,000 cubic feet of records were prepared and sent to the Department of Archives and History for review and approval.

### Facilities

A new uniform graphic sign system for all University Libraries was implemented. Unfortunately, the signs were so well received that many disappeared. New security measures have since been developed. One significant result of the new graphic system was a reduction in directional questions asked at the Reference Desk, allowing the staff to devote more time to other meaningful services.

During the fall additional shelving was added in the Gunnin Architectural Library, providing more space for that library's growing collections. Also added in that library was the 3M Tattle Tape Book Detection System that matches the one in Cooper Library. This new system provides greater security for the valuable collections housed in Gunnin library.

### Library Usage

For the second year in a row, circulation statistics have increased, indicative of more materials being used. There also was a decrease in the number of users entering the Cooper Library, which may be explained by the accessibility of LUIS on some 1,300 terminals outside of the libraries, which eliminates going to the library to use the card catalog.

Reference statistics have increased generally, but as noted earlier, the number of directional questions answered by the reference

staff has decreased due to the new sign system. Significantly, the number of regular reference questions as well as research questions has increased substantially.

Interlibrary loans both to and from Clemson increased by nearly 25 percent. The top six or seven libraries who borrow most heavily from us are private corporations. The most frequent borrower was Westvaco.

### Fund Raising

Using a data base of donors made up of those involved in the Bookplate Mailer campaign, the library (with help from the Development Office and its Library Development Advisory Committee) distributed letters urging those who have given to the libraries in the past to become "Patrons" of the libraries.

### Personnel

A major reorganization effort in the technical services area was planned during the year. The three technical services units will be brought together under a head of technical services. A position vacated by the resignation of the head of cataloging was redesigned for this new position and the search begun. The libraries expect to fill the position shortly after the beginning of the new fiscal year.

A number of library staff members continue to serve in areas of responsibility in local, state, regional and national professional library and archival organizations.

## COMPUTING SERVICES

### Computer Center

Great strides were made in 1985-86 toward implementing the long-range plans put in place last year. Despite a year of budget cuts, hiring freezes and lack of suitable space, the Center generated the resources necessary to conduct an aggressive expansion program and to build the framework of a plan to address the continued space and funding problems.

The perennial problem of shortage of suitable space to house computing equipment is nearing a solution with the University's plans to lease a facility to be constructed at the Clemson Research Park. This facility, about eight miles from campus, will house the IBM mainframe computing operations and the Information Systems Development Group and will be connected by fiber optic links to the various work-stations and computing devices on campus. The building is scheduled to be completed and occupied by September 1987. Location of the IBM mainframe at this distance from campus will have no deleterious effect on the



performance of the computing network.

Computing services at Clemson are delivered over a sophisticated network of computers of various sizes, types and capabilities. Planning has been concentrated on the network as a whole rather than on its individual components. The overriding network design criterion is that communication should be possible between all devices on the network, permitting resource sharing and the most efficient use of equipment.

Expansion and amalgamation of the IBM and DEC networks have proceeded rapidly. The high-speed DEC network is approximately 50 percent complete, with the remainder due to be installed in 1986-87. The IBM component of the network has been complete for some time, and the interface between these two major network components is continually being refined. Clemson's network communication with computing facilities around the world, available through BITNET, TELENET and CSNET, will be enhanced by the University's selection as a major network node on SURAnet, a new high-speed network for use by research institutions.

The IBM 3081 mainframe computer, although running at peak capacity for most of the year, was able to meet the needs of the University and its contractual obligations as a supplier of computer services to other state agencies. This computer, which has remained in operation longer than any of its predecessors, is scheduled for replacement in 1986-87. Upgrades of peripheral equipment, particularly disk drives and printers, during 1985-86 provided improved performance at lower cost and completed replacement of older, high-maintenance-cost devices.

The computing power in the VAX portion of the network was significantly increased by the addition of a VAX 8600 computer. This computer, funded by the College of Agriculture and maintained by the Computer Center, supports the CUFAN network. CUFAN is a statewide agricultural information network accessible from remote personal computers or terminals by means of a local telephone call. Despite the addition of the VAX 8600, the VAX network is still under-powered, particularly for the increasing number of graphics applications it is being called upon to support. To alleviate this problem, a VAX 8650 computer has been ordered for delivery in 1986-87. It is expected that the demand for services over the VAX network will continue to expand at a rapid rate, particularly as the volume of University research grows, and the Computer Center will face a major challenge in meeting that demand.

The integration of the use of the microcomputer into the University curriculum has created heavy demands for public-access clusters of microcomputers for general student use. The Computer Center has generated funds to meet demand and opened seven new microcomputer laboratories in the 1985-86 academic year, giving a total of 256 microcomputers in public-access clusters. The increasing demand for such facilities, in some measure exacerbated by the fact that few Clemson students own their own microcomputers, is making it increasingly difficult to identify the funds needed to provide sufficient workstations. The University needs to encourage students to purchase their own microcomputers, thus reducing the University's expense in acquiring, maintaining, housing and supervising a vast array of equipment that must be replaced every few years. It is unlikely that many students will purchase microcomputers, however, unless they are re-

quired to or unless they can easily and inexpensively connect them to the University computing network from their dormitory rooms. A test is under way to determine the feasibility of using the University's telephone system as the connecting vehicle.

Modest progress has been made toward implementing the University's office automation plan. Office automation systems have been installed in various colleges and administrative units, and work has progressed to connect these systems to the overall computing network. The ability of office automation equipment of various vendors to communicate with each other in an effective manner has been disappointing. While the office automation network and the computer network will remain indistinguishable -- accommodating a variety of devices from different vendors -- the question of whether the University should adopt a single office automation software for interdepartmental communications remains open. Given the rate of investment in office automation systems, this question must be resolved within the next academic year.

Clemson continues to maintain a sophisticated computing network providing a level of service to the University and the state on a par with the finest university facilities. However, the Center's heavy reliance on outside revenue as a source of funding is cause for concern. While that revenue seems to be assured at least for the next three years, the Center's staff is increasingly shifting its attention to identifying and securing new contracts that will assure a continuing revenue stream. The record in this regard is good, and the University can be reasonably confident that Clemson will be able to retain its place in the top flight of computing institutions.

#### Division of Information Systems Development

The Division of Information Systems Development (DISD), which develops computer software systems under contract primarily for state agencies, experienced another year of substantial growth. Revenue was up 60 percent over 1984-85, which was in turn 50 percent greater than 1983-84. Staffing levels were increased to accommodate new and expanded contracts, and additional opportunities were provided to students to work on real-world computing problems in concert with their academic programs.

For a number of years, the major DISD contract has been to provide systems development and maintenance services on the Medicaid Management Information System (MMIS) for the Department of Social Services (DSS). In 1984 the state created the Health and Human Services Finance Commission (HHSFC) responsible for overseeing the Medicaid program. Since HHSFC was under no obligation to continue to acquire MMIS support services from DISD, the future of DISD's major contract was not certain. However, a new three-year contract valued in excess of \$2 million with two one-year extensions was negotiated with HHSFC, and an expanded effort in MMIS support is under way.

DISD continues to provide support to DSS in the design and development of a new Title IVD Child Support System, a \$900,000, three-year project now into its second year. A new \$115,000 contract with the Department of Health and Environmental Control (DHEC) has been signed.



It is hoped this will lead to future contracts. DISD's three-year contract to develop an administrative system for the state's TEC colleges is nearing completion, but will be more than compensated for by the new contracts.

The number of new and expanded contracts signed over the past two years has led to an extreme shortage of space at DISD to house programmers and analysts. Construction of a new facility at the Clemson Research Park to house DISD and the Computer Center's IBM mainframe operations should solve this problem.

DISD constantly seeks new opportunities for growth and has succeeded in increasing its business over the past few years. While the software development marketplace remains extremely volatile, DISD is building a reputation for developing software systems of high quality at low cost.

### Administrative Programming Services

Administrative Programming Services (DAPS) develops and maintains computerized information systems for the University and helps administrators in all departments retrieve information from administrative databases in a form that is meaningful and specific to the task. A key component of DAPS' mission is to design coordinated information systems supported by an integrated University database that uses standardized data definitions.

The department continues to add new administrative systems and responsibilities as the University takes advantage of automation opportunities. DAPS' level of staffing has been almost constant for six years. In addition to supporting central administrative systems, the department provides increasing assistance to University administrators and faculty who are attempting to retrieve and analyze information from available databases.

During 1985-86, DAPS accomplished the following tasks:

- o Helped install NOTIS library system for R.M. Cooper Library. Preparations were made for the installation module in July 1986.
- o Implemented an artificial intelligence software system (INTELLECT) for use by administrators in retrieving information using English language statements. Information concerning faculty and staff can now be retrieved from several dean's offices.
- o Helped implement fiscal year-end pay adjustments and budget/accounting processing.
- o Helped several departments select and install microcomputers for administrative use and for processing data from administrative systems.
- o Provided software support for the spring and fall budget processes. Expanded the system to provide a microcomputer interface for interested departments.
- o Installed the third major phase of the student database, a financial aid and collections system. Financial Aid tracking/recording student receivables functions are now completed.
- o Expanded the departmental access system that allows academic advisers, department heads and deans to retrieve student transcript

information for appropriate majors from terminals in offices.

- o Programmed a major portion of the facilities inventory management system.

- o Expanded the INTELLECT system to include budgeted position data.

- o Implemented the transfer evaluation system in the student database.

- o Designed and programmed the Student Placement Office system.

- o Enhanced the Office for Development's data systems to include pledge processing and other new features.

- o Installed a University vehicle/traffic system.

- o Installed an electronic funds transfer capability for payroll checks.

- o Helped implement a University-wide office automation and electronic document distribution system (DISOSS from IBM).

- o Expanded financial systems to make them more accessible by authorized persons campus-wide.

- o Upgraded the software used by DAPS to develop administrative systems, including the database management system used (IDMS) and the teleprocessing monitor (IDMS/DC).

- o Maintained the effectiveness and on-going operation of 60 administrative systems and responded to requests for enhancements by major users.

- o Supported the use of data retrieval languages such as SAS and CULPRIT by administrative staff.

- o Experimented with a new on-line systems development productivity aid called ADS/On-Line.

- o Determined the requirements for migrating the Physical Plant systems on the System/36 to the mainframe computer.

- o Studied ways to use the bar coded ID in Student Affairs.

- o Conducted research and development activities for a curriculum database and a student advisement/degree progress evaluation system.

- o Studied postal rate incentives and developed software to take advantage of some of them.

- o Supported staff professional development activities such as publishing articles in national periodicals and attending professional conferences.

## OFFICE OF HUMAN RESOURCES

The Office of Human Resources is charged with coordinating and directing the efforts of the University to meet the objectives of affirmative action, equal employment opportunity and the goals of the State Desegregation Plan. Particular significant efforts have been made during the past year to increase the awareness of all employees and students of their rights and responsibilities.

A comprehensive manual entitled "Affirmative Action and Equal Employment Opportunity" was developed and distributed to all departments. This manual includes policies and guidelines as an aid in re-



cruiting and selecting employees, as well as policies and programs addressing sexual harassment and acquired immune deficiency syndrome (AIDS). The first such workshop drew 200 University administrators. Workshops featuring speeches by authorities on the state's desegregation and affirmative action efforts, plus speakers who discussed AIDS from a medical and legal point of view, were developed by the staff of Human Resources. Because this was an effective method in keeping our University community informed on the current status of these issues, the workshop format will be used on a regular basis in the coming year for presenting information to all faculty, staff and students.

A national conference, "Vital Issues: The Future of Affirmative Action and Desegregation in Higher Education," also was presented by the Office of Human Resources and was attended by 200 higher education administrators from across the country. Plans are being made for a second conference. The Office of Human Resources also is channeling efforts into minority scholarship fund raising and is actively developing proposals for programs and resources. Several projects are expected to make additional educational opportunities available to many students.

#### INSTITUTIONAL ADVANCEMENT

The Institutional Advancement Division consists of the Development Office, Alumni Relations and University Relations. The three program areas work together to attract private support of academics, to provide services for Clemson alumni and friends and to meet the University's promotion and media-relations needs. A report on each area follows.

##### Development Office

The objectives of Clemson's private support efforts are deliberate and broad-based. They encompass growth in the unrestricted permanent endowment, expansion of all phases of general and endowment support for faculty, increased sources of student financial aid and further development of the annual Loyalty Fund program, which enhances the total academic environment.

While state appropriations are a part of the total support for the educational activities at Clemson, more than 50 percent of the total budget must come from other sources. In that context, the ultimate quality of the University rests with private support from business, industry, alumni and friends of the University.

More than \$6.8 million was contributed from July 1, 1985, through June 30, 1986, as Clemson's fund-raising program completed its first 12-month year since changing from a calendar to a fiscal reporting cycle. The total represents gifts from all support groups, including alumni. Some 12,530 donors contributed.

Last year's fund-raising period was 18 months long, and this year's figures are greatly enhanced by a \$1.1 million cash gift. But even given those qualifications, the figures for the 1985-86 year are impressive because they reflect unprecedented support for and interest in academic giving by Clemson alumni and friends and the private sector in general.

Alumni participated at a record level in the Loyalty Fund. Clemson's alumni-participation percentage is about 25 percent (11,275 people), more than twice the national average. Loyalty Fund gifts from alumni and friends exceeded \$1 million last year.

The mission of the Development Office is to attract -- to the fullest extent possible -- the private support of Clemson's constituent support groups to supplement the University's tax-assisted budget in order to maintain and enhance academic excellence at all levels. The development staff, consisting of six full-time professionals, conducts annual and capital giving programs utilizing many alumni and other volunteers.

Also a primary responsibility of the Office for Development is the coordination of all academic fund-raising programs campuswide. The Campus Annual Fund Coordinating Council was established in 1984 by the Office for Development to help deans, department heads and professors cultivate and solicit private gifts for their school, college or unit. The council, which is chaired by a college dean, comprises all deans and representatives from the library, athletics, various institutes and other campus entities.

Private support from the Loyalty Fund provides funds for scholarships, professorships, library acquisitions and a myriad of projects and programs aimed at strengthening academic programs. Since less than 50 percent of the University's budget is provided by the state, private support as a supplement to state assistance is critically important to Clemson's mission of teaching, research and service.

As Clemson approaches its Centennial celebration in 1989, the Office for Development will conduct the University's first fund-raising effort for construction and endowment funds. This Centennial campaign will seek gifts from alumni, friends, corporations, foundations and other groups to strengthen Clemson's endowment as a means of preparing for the University's next 100 years of service.

### Alumni Relations

In the land-grant tradition of service to all its graduates and friends, the major thrust of the alumni relations division of institutional advancement is to provide a variety of programs that helps graduates keep in touch with their alma mater. These programs take the form of Clemson Club meetings, seminars, constituent group activities, special class activities, career services and continuing education.

Clemson alumni are recognized the world over for their spirit and loyalty to the University, in the academic arena as well as on the athletic fields. Members of the "Clemson family" have served in national, international, state and local affairs. The contributions



they make inure to the benefit of the citizenry of which they are such a vital part. The Alumni Association has an extensive recognition program designed to make others aware of the successes and accomplishments of men and women who wear the Clemson ring with such pride and do so much to promote the teaching, research and public service commitment of the University.

All functions and services of the international Alumni Association, which has some 45,000 members, are coordinated at the Clemson Alumni Center. This 14,000-square foot structure was built, equipped and furnished by alumni of the institution through a special three-year capital campaign, and given to the University. All alumni relations activities of the University are housed here as well, including an extensive computerized records-keeping system that has won national acclaim as one of best in higher education. Accurate records of address, employment and biographical information are retained on those individuals who graduate from the University, as well as those who express a desire to become involved with Clemson in any way.

Alumni of the University continue to support the annual loyalty fund with gifts that make possible an extensive scholarship program that provides hundreds of students with financial aid, fund alumni professorships which identify Clemson's best classroom teachers, and provide awards for distinguished achievements in research, public service and teaching.

#### University Relations

The Division of University Relations provides news and public information services, electronic and photographic services, publications and graphics services, visitor services and general public relations counsel to the University's academic and administrative divisions, including the Cooperative Extension Service and the S.C. Agricultural Experiment Station.

#### Department of Agricultural Communications

The Department of Agricultural Communications serves the communications needs of the public service agencies in the College of Agricultural Sciences. A primary goal is to provide the people of South Carolina information that will help them improve their productivity and standard of living. This has been accomplished through:

- o Providing news articles, columns and features for the general media, both print and broadcast, and for specialized publications.
- o Providing agriculture, health, nutrition, home care and other publications of value to homeowners, growers, families and young people.
- o Developing exhibits for use throughout South Carolina.
- o Working with Extension employees to develop their communication skills.

## Department of News Services

The Department of News Services continued to provide the University with a means of communication to the public through external news media and internal news vehicles, including "Clemson University News" and the campus newsletter.

Traditional services -- generating news and feature stories about the University's educational, public service and research programs; editing and marketing regular faculty-written columns and book reviews; coordinating coverage of campus events and speakers; handling news conferences; and acting as liaison between the University and the print and broadcast media -- continued.

## Department of Electronic and Photographic Services

The Department of Electronic and Photographic Services is responsible for providing production support services in television and radio, photography and visual aids for the University's academic and administrative programs, including the Cooperative Extension Service and the S.C. Agricultural Experiment Station.

The Electronic Services group provides TV studio production, production of video and audio tapes for teaching and other purposes, multi-image productions, tele-lecture equipment loans, and audio and video teleconferencing. The Photographic Services group provides color slides, black-and-white and color photographs, artwork for audio-visual presentations and cinematography. The Educational Resources group provides audio-visual equipment loans; film, multi-image, video and audio tape resources for loan to units of the University; and distribution of publications, bulletins, pamphlets and other educational material for the Cooperative Extension Service and the S.C. Agricultural Experiment Station.

## Department of Publications and Graphics Services

The Department of Publications and Graphics Services ensures that Clemson University's printed communications maintain the highest standards of writing and design and that they project a positive, accurate image to the University's various publics. To that end, a professional staff of writers, designers and production personnel provides the services needed to create and coordinate a publication project from the planning stage through delivery of the finished product.

During 1985-86, the department had in production 480 jobs -- brochures, fliers, posters, programs, letterheads, catalogs, directories and exhibits -- directed toward student recruitment, fund raising, providing information, and promoting the activities and services of the University.

The department continued its efforts to increase production efficiency and decrease production costs to clients. Progress was made in developing consistent design and copy formats to reduce production turnaround and contribute to a distinctive University image in print. Time and cost savings were realized in the typesetting phase of publications



production due to a dramatic increase in the use of on-campus typesetting equipment and through telecommunications with commercial vendors.

### Visitor Programs

Visitor Programs administers the Visitors Center, the Board of Visitors program, the Speakers Service and two campus historic landmark houses -- Fort Hill and Hanover House.

Clemson's traditional Board of Visitors program has both a new philosophy and a new organization. The program includes two-year membership commitments, two campus visits annually and a membership roster of 30 business and community leaders. Also, members are assigned to four working committees: academic affairs, legislative relations, media and research.

The University's full-service Visitors Center, which celebrated its second anniversary on June 4, 1986, provides a variety of services to meet the information needs of an increasing number of campus visitors. Services include general information, guided and self-guided tours, audio-visuals and publications.

### STUDENTS

The 1985-86 academic year marked the highest on-campus enrollment, with 12,126 students registered for classes -- 10,970 full time and 1,156 part time. An additional 767 were in various off-campus programs, bringing the total enrollment to 12,893, a slight decline from last year. Of the total enrollment, 2,459 were graduate students.

The College of Engineering again had the highest on-campus enrollment with 3,350 students. The College of Commerce and Industry was second with 2,624, followed in order by Sciences, Education, Liberal Arts, Agricultural Sciences, Architecture, Forest and Recreation Resources, and Nursing.

Higher education continued to become increasingly accessible as evidenced by the number of freshmen entering college with advanced standing. In the 1985-86 fall semester, new high school graduates entered Clemson with advanced standing by means of College Board Advanced Placement courses (483 students, 3,782 credit hours) and by concurrent enrollment in high school and college or enrollment in summer school (63 students, 418 credit hours).

At Clemson, performance in high school has proven to be the best single predictor of success in the freshman year. The class ranks of entering freshmen remained essentially unchanged, with 40 percent of the class entering in fall 1985 ranked in the top 10 percent of their class, 65 percent in the top 20 percent, and 95 percent in the top 50 percent. In 1985 the freshman class average Scholastic Achievement Test (SAT) score of 1,012 compared with an average of 906 reported by the College Board for all high school seniors. It is also the highest average among state-supported institutions in South Carolina.

Of the 7,675 new applications for admission processed for 1985-

86, 4,900 were accepted, and 2,712 actually enrolled (including freshmen and transfer students). South Carolina residents accounted for 70 percent of the 12,893 students, including those enrolled in off-campus programs. Clemson students come from all 46 South Carolina counties, 48 states, Puerto Rico, the District of Columbia, the Virgin Islands and 81 foreign countries (465 students).

Greenville County continued to have the most students enrolled on campus (1,166). Pickens County was second with 996, followed in order by Anderson, Oconee, Charleston and Spartanburg counties. Most out-of-state students came from North Carolina (555), Georgia (554) and Florida (455).

Computerized pre-registration helped the record number of students get off to a smooth start for fall classes. More than 90 percent were pre-registered and had their course schedules completed before they arrived on campus to begin classes.

#### Fall Semester Enrollment Comparisons for Recent Years

<u>Year</u>	<u>Undergraduate</u>	<u>Graduate and Others</u>	<u>Total</u>
1972-73	7,686	2,071	9,757
1973-74	7,910	2,202	10,112
1974-75	8,171	2,415	10,586
1975-76	8,576	2,785	11,361
1976-77	8,620	2,763	11,383
1977-78	8,708	2,566	11,274
1978-79	8,925	2,553	11,478
1979-80	9,291	2,457	11,748
1980-81	9,427	2,152	11,579
1981-82	9,918	2,008	11,926
1982-83	10,151	1,983	12,134
1983-84	10,217	2,242	12,459
1984-85	10,488	2,438	12,926
1985-86	10,434	2,459	12,893

The 1985-86 figures include 549 students attending off-campus institutes and 151 in the Clemson-Furman University Master of Business Administration degree program.

The on-campus enrollment of women at Clemson reached an all-time high during the 1985 fall semester. There were 5,145, of which 4,418 were undergraduates. Enrollment of undergraduate women increased nearly 2 percent over last year, and women now constitute approximately 43 percent of the on-campus undergraduate enrollment.

The Clemson student body continues to be a working group, receiving a significant amount of financial assistance in the form of loans, grants, scholarships and employment. In 1985-86 approximately 2,800 students earned an estimated \$8 million working for the University. This figure does not include earnings from off-campus employment. Clemson awarded 482 long-term loans totaling \$569,000. The University also approved and certified 2,974 guaranteed student loans from a variety of lending institutions. Excluding donor-selected scholarships, 716 scholarships and grants valued at \$701,745 were awarded.



The number of students receiving Pell Grants was 1,488, with awards totaling \$1,913,775. In all, an estimated 68 percent of the student body received an estimated total of \$18 million in financial assistance.

Students at Clemson University enjoyed educational experiences outside the classroom through participation in student organizations. The number of organizations has increased steadily, and Clemson now recognizes more than 260 student groups. Half of these groups directly complement the academic experience by providing career-oriented fellowship, programs and trips to professional conferences. Our students also enjoy competition, socialization and fellowship in sports, social and religious organizations. In addition, more than 40 groups have been formed to associate students interested in fine arts, media, military, government and community service.

Student Government continues to add new programs for the student body. Approximately 300 people this year represented the students in the senate, court system and Student Traffic Review Board, and 93 students were appointed to University committees. This year's services included copy machines, typewriters, refrigerator rentals, security shuttles and free legal aid. In addition to traditional activities, Student Government sponsored a Career Expo to educate students about job opportunities; 40 companies participated.

The TAPS yearbook, The Tiger newspaper and WSBF radio are enjoying a resurgence of student involvement. The Chronicle, Clemson's variety magazine, was revived after two years without publication and will produce two issues in the coming year.

Clemson's 11 sororities and 19 fraternities claimed a total membership of 2,480 students. Sorority women emphasized academic excellence and maintained an average grade point ratio of 2.84, which was higher than the University's overall female student average of 2.68. The Interfraternity Council instituted a fraternity Honor Court. The Pan Greek Council claimed in its membership 26 percent of Clemson's minority students.

Career Services, composed of Placement and Cooperative Education, provides students with information on career opportunities, teaches job search skills, offers the chance for work experience and coordinates employer contacts with the University.

A survey of May 1985 graduates shows that 61 percent had jobs at graduation and that eight months after graduation only 2.3 percent were still unemployed and looking for work. This year's class should have about the same job placement statistics.

The 1985-86 academic year was a period of continued growth for the Cooperative Education Program. Student enrollment and student earnings rose to 567 and \$3.31 million, respectively. In addition, 40 employers initiated cooperative education agreements with Clemson University during the past year.

The Clemson University Union accomplished its 1985-86 goal by providing more than 800 social, cultural and recreational activities for the campus community during the year. These programs were planned by more than 300 student volunteers under the leadership of the Union Board and assisted by a professional staff. Included in the varied activities for the year were the First Friday Celebration Concert in the Outdoor Theater; John Cougar Mellencamp, Sting and Lee Greenwood

concerts in Littlejohn Coliseum; the 10th anniversary celebration of the Union; an outstanding Performing Artist Series; and more than 80 University Union short courses. The Union provides an atmosphere where students can develop leadership, business and interpersonal skills, and sponsors worthwhile extracurricular activities for the total campus population.

#### Number and Percent of Black Students

<u>Year</u>	<u>Number</u>	<u>Percent</u>
1972	179	2
1973	211	2
1974	216	2
1975	338	3
1976	307	3
1977	336	3
1978	290	3
1979	341	3
1980	305	3
1981	325	3
1982	429	4
1983	472	4
1984	528	4
1985	671	5

#### Student Faculty Ratio (Full-Time Equivalent)

<u>Year</u>	<u>Ratio</u>
1972	14.6:1
1973	16.8:1
1974	17.9:1
1975	18.3:1
1976	17.6:1
1977	16.3:1
1978	15.9:1
1979	16.0:1
1980	15.6:1
1981	16.4:1
1982	16.6:1
1983	17.0:1
1984	16.1:1
1985	15.4:1

#### Average College Board Score of Freshman

<u>Year</u>	<u>Score</u>
1972	995
1973	982
1974	984
1975	983



Average College Board Score of Freshman Cont.

<u>Year</u>	<u>Score</u>
1976	996
1977	985
1978	1,000
1979	1,002
1980	1,005
1981	1,007
1982	1,017
1983	1,014
1984	1,012
1985	1,012

Number of Teachers  
(Full-Time Equivalent Teaching Faculty)

<u>Year</u>	<u>Teachers</u>
1972	614.9
1973	578.4
1974	591.8
1975	602.5
1976	611.3
1977	654.4
1978	675.6
1979	691.8
1980	718.2
1981	709.7
1982	720.9
1983	713.5
1984	762.5
1985	797.3

Number in Freshman Class  
(New Students)

<u>Year</u>	<u>Number</u>
1972	1,919
1973	2,034
1974	1,949
1975	1,901
1976	1,861
1977	1,838
1978	2,020
1979	1,998
1980	2,008
1981	2,284
1982	2,321
1983	2,122
1984	2,188
1985	2,259

### Acceptance Rate of Applicants\*

<u>Year</u>	<u>Score</u>
1972	83%
1973	83%
1974	84%
1975	77%
1976	69%
1977	69%
1978	69%
1979	60%
1980	59%
1981	59%
1982	52%
1983	63%
1984	65%
1985	64%

\*Acceptance rate is based upon the total number of applicants rather than the number of decisions. Rate calculation based upon decisions would result in approximately a five-point increase in the rate for all years.

### Retention Rate of Students (Freshman Class)

<u>Year</u>	<u>Score</u>
1971	84%
1972	82%
1973	83%
1974	83%
1975	82%
1976	84%
1977	84%
1978	87%
1979	87%
1980	87%
1981	89%
1982	87%
1983	87%
1984	85%

### Number of On-Campus Students in Summer School

<u>Year</u>	<u>Number</u>
1972	5,232
1973	6,267
1974	5,997
1975	6,275
1976	6,100
1977	6,301
1978	6,393



Number of On-Campus Students in Summer School Cont.

<u>Year</u>	<u>Number</u>
1979	6,708
1980	6,858
1981	6,897
1982	7,149
1983	7,442
1984	7,418
1985	8,126

Number of Dorm Beds and Percent Being Used

<u>Year</u>	<u>Beds</u>	<u>Percent</u>
1972	5,174	100
1973	5,330	102
1974	5,592*	101
1975	5,616*	103
1976	5,625*	103
1977	5,662*	103
1978	5,683*	104
1979	5,726*	106
1980	6,317*	112
1981	6,864*	100
1982	7,149*	105
1983	7,113*	104
1984	6,976*	102
1985	6,986	102

---

\* Includes beds in the Clemson House:

1974 - 252	1980 - 329
1975 - 262	1981 - 330
1976 - 271	1982 - 328
1977 - 308	1983 - 331
1978 - 317	1984 - 331
1979 - 324	1985 - 333

Fall Semester 1985 Enrollment by Colleges, and Degrees Awarded  
December 1984-August 1985

	Total Enrollment Fall Semester	Degrees					Total
		Associate	Bachelor's	Master's	Specialist	Doctorates	
Agricultural Sciences .....	738	0	121	55	0	10	186
Architecture .....	509	0	103	42	0	0	145
Commerce & Industry.....	2,805	0	525	86	0	4	615
Education .....	1,773	0	215	133	8	0	356
Engineering.....	3,361	0	654	130	0	14	798
Forest & Rec. Resources .....	453	0	79	24	0	2	105
Liberal Arts.....	958	0	168	10	0	0	178
Nursing .....	439	0	77	3	0	0	80
Sciences .....	1,666	0	232	51	0	22	305
Non-Degree.....	191	..	...	..	.	..	...
TOTALS.....	12,893	0	2,174	534	8	52	2768

Degrees awarded since 1896 (through August 1985) total 57,140 of which 426 have been associate degrees; 46,054 bachelor's degrees; 9,741 master's degrees; 130 education specialist degrees; and 789 doctorates. Includes 423 Clemson-Furman MBA degrees awarded May 1972-August 1985.



Sport	Home	Away	Neut	ACC	Overall	Pct	ACC Reg Finish	ACC Trn Finish	National Ranking	All-ACC Players	All-American Players
*Women's Tennis	12-1	7-1	7-1	7-0	26-3	.897	1st	1st	8th	6	2
*Men's Soccer	15-1	4-2	2Ties	5-1	19-3-2	.833	1st	NA	4th	4	3
*Men's Tennis	8-0	7-4	16-3	7-0	31-7	.816	1st	1st	5th	3	3
*Wrestling	9-1	1-2	6-3	3-2	16-6	.727	3rd	4th	19th	1	1
*Women's Swimming	3-1	2-1	0-0	2-1	5-2	.714	3rd	3rd	7th	8	6
Baseball	23-7	15-11	4-3	9-4	42-21	.667	3rd	3rd	----	2	0
*Men's Basketball	14-5	3-8	2-2	3-12	19-15	.559	7th	5th (T)	----	0	0
*Football	3-3	3-2	0-1	4-3	6-6	.500	3rd (T)	NA	----	4	1
Women's Basketball	8-6	3-8	1-2	4-11	12-16	.429	6th	5th (T)	----	0	0
*Men's Swimming	3-2	0-3	0-0	2-2	3-5	.375	4th	1st	35th	5	0
Volleyball	3-6	6-7	4-13	3-4	13-26	.333	6th	5th (T)	----	1	1
*Men's Cross Country							NA	3rd	----	1	0
*Men's Indoor Track							NA	NA	----	NA	1
*Men's Outdoor Track							NA	2nd	30th	11	2
*Women's Cross Country							NA	2nd	15th	1	0
*Women's Indoor Track							NA	NA	19th	NA	1
*Women's Outdoor Track							NA	4th	23rd (T)	3	2
*Golf							NA	4th	21st	0	0
Men's Totals	75-19	33-32	28-12-2	33-24	136-63-2	.635	2 1st	2 1st	5 top 30	31	11
Women's Totals	26-14	18-17	12-16-0	16-16	56-47	.544	1 1st	1 1st	5 top 30	19	12
OVERALL TOTALS	101-33 (.754)	51-49 (.510)	40-28-2 (.586)	49-40 (.551)	192-110-2	.635	3 1sts	3 1sts	10 top 30	50	23

\*Denotes Advanced to post-season play

STATEMENT OF CURRENT FUNDS REVENUES, EXPENDITURES AND OTHER CHANGES  
FOR THE YEAR ENDED JUNE 30, 1986

	CURRENT YEAR		
	<u>UNRESTRICTED</u>	<u>RESTRICTED</u>	<u>TOTAL</u>
REVENUES			
Student Fees	\$ 27,269,681.72		\$ 27,269,681.72
Federal Appropriations	11,803,169.58		11,803,169.58
State Appropriations	92,574,895.88		92,574,895.88
Local Appropriations	1,800.00		1,800.00
Federal Grants and Contracts	1,025,181.60	\$ 7,709,142.63	8,734,324.23
State Grants and Contracts	72,748.39	1,402,383.85	1,475,132.24
Local Grants and Contracts		15,104.33	15,104.33
Private Gifts, Grants and Contracts	690,972.26	8,414,416.33	9,105,388.59
Endowment Income	9,266.36	311,135.99	320,402.35
Sales and Services of Educational Departments	1,525,409.75		1,525,409.75
Sales and Services of Auxiliary Enterprises	34,923,873.04		34,923,873.04
Other Sources	<u>5,894,222.51</u>	<u>911,533.05</u>	<u>6,805,755.56</u>
TOTAL REVENUES	<u>\$175,791,221.09</u>	<u>\$18,763,716.18</u>	<u>\$194,554,937.27</u>
EXPENDITURES AND MANDATORY TRANSFERS			
Educational and General			
Instruction	\$ 50,891,341.55	\$ 1,560,385.23	\$ 52,451,726.78
Research	6,606,811.61	5,562,255.52	12,169,067.13
Research - Agricultural Experiment Station	16,625,621.91	2,059,579.89	18,685,201.80
Extension and Public Service	1,299,732.50	1,378,365.71	2,678,098.21
Extension and Public Service - Cooperative			
Agricultural Extension Service	23,751,330.28	908,643.48	24,659,973.76
Extension and Public Service - Regulatory			
Service	3,872,597.75	960,846.81	4,833,444.56
Academic Support	9,046,198.82	617,635.17	9,663,833.99
Student Services	4,692,252.88	258,152.91	4,950,405.79
Institutional Support	12,407,948.53	264,940.37	12,672,888.90
Operation and Maintenance of Plant	10,431,067.43	3.35	10,431,070.78
Scholarships and Fellowships	<u>53,016.44</u>	<u>5,163,023.76</u>	<u>5,216,040.20</u>
	<u>\$139,677,919.70</u>	<u>\$18,733,832.20</u>	<u>\$158,411,751.90</u>



Mandatory Transfers for:			
Indirect Cost Remitted to State	\$ 212,382.26		\$ 212,382.26
	<u>\$ 212,382.26</u>		<u>\$ 212,382.26</u>
Total	<u>\$139,890,301.96</u>	<u>\$18,733,832.20</u>	<u>\$158,624,134.16</u>
Auxiliary Enterprises:			
Auxiliary Enterprises Expenditures	\$ 32,695,132.74	\$ 29,883.98	\$ 32,725,016.72
Mandatory Transfers for:			
Debt Service Requirements	2,190,000.00		2,190,000.00
Total	<u>\$ 34,885,132.74</u>	<u>\$ 29,883.98</u>	<u>\$ 34,915,016.72</u>
TOTAL EXPENDITURES AND MANDATORY TRANSFERS	<u>\$174,775,434.70</u>	<u>\$18,763,716.18</u>	<u>\$193,539,150.88</u>
OTHER TRANSFERS AND ADDITIONS/(DEDUCTIONS)			
Indirect Cost Recovered		\$(1,789,382.25)	\$ (1,789,382.25)
Restricted Gifts Endowed		(12,102.30)	(12,102.30)
Nonmandatory Transfer Among Funds	\$ 952,842.42	(1,625,674.99)	(672,832.57)
Excess of Restricted Receipts over Transfers to Revenues		2,268,403.98	2,268,403.98
Realized Losses on Investments and Administrative Costs		(32,171.16)	(32,171.16)
Remitted to Clemson University Foundation		(2,338.97)	(2,338.97)
TOTAL OTHER TRANSFERS AND ADDITIONS/(DEDUCTIONS)	<u>\$ 952,842.42</u>	<u>\$(1,193,265.69)</u>	<u>\$ (240,423.27)</u>
NET INCREASE/(DECREASE) IN FUND BALANCE	<u>\$ 1,968,628.81</u>	<u>\$(1,193,265.69)</u>	<u>\$ 775,363.12</u>

PUBLIC SERVICE PROGRAMS OF THE COLLEGE  
OF AGRICULTURAL SCIENCES  
Luther P. Anderson, Dean

The College of Agricultural Sciences administers statewide public service programs in addition to its programs for resident instruction. Among its public service functions are administration and coordination of the varied activities and services of the South Carolina Agricultural Experiment Station, the Cooperative Extension Service, the Division of Regulatory and Public Service Programs and the Livestock-Poultry Health Department. Reports of these divisions follow.

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION  
W. Cecil Godley, Director

The South Carolina Agricultural Experiment Station at Clemson conducts the state's only state-funded agricultural research program. Scientists in 11 departments of the College of Agricultural Sciences provide expertise for this program, while home economics research is conducted at Winthrop College.

Facilities at Clemson and at four research and education centers located across the state provide indoor and outdoor laboratories for scientists in agricultural economics, agricultural engineering, aquaculture, fisheries and wildlife, agronomy, animal science, dairy science, entomology, food science, horticulture, plant pathology and poultry science.

Branch research and education centers are Edisto at Blackville, Sandhill at Pontiac, Pee Dee near Florence and Coastal near Charleston. Simpson Experiment Station near Pendleton also serves as an outdoor laboratory for researchers and faculty at the University campus.

Researchers at these regional centers conduct studies and carry out experiments relating to growers and crops in their respective geographic areas under constraints and conditions of different soils and climates.

Created by Congressional Act in 1886, the Experiment Station is state controlled and funded with annual appropriations from both the South Carolina General Assembly and Congress.

In all 50 states, Experiment Stations conduct both cooperative and complementary research. They avoid duplication of efforts and build on the foundation of information which has been primarily responsible for advances made in agriculture during the past 100 years.

To meet future challenges, the South Carolina Agricultural Experiment Station will continue to produce new research findings to add to those of its counterparts across the country in meeting a common goal -- creating better standards of living for people through the wisest and best use of natural resources.

The following summary is a capsule review of the extensive research program at the Experiment Station. Many important studies may have been omitted, and those which follow are intended only to



illustrate the scope of the station's total program:

### Agricultural Economics and Rural Sociology

Development and implementation of public service programs utilizing methods and concepts of social science is the department's mission. Its purpose is to enhance quality of life, give policy-makers information to make informed decisions, and improve general economic well-being of all sectors locally, regionally, nationally and internationally. In turn, these public service programs are supported by research efforts focusing on contemporary issues and problems.

Among its studies, the department focused on financing rural water systems, changes in the state's population and in the structure of agriculture and marketing techniques.

An examination and analysis of financial records of the state's rural water systems indicate that withdrawal of federal financial aid, beginning in 1981, has created considerable financial instability for the systems. The magnitude of expected financial difficulties will be categorized later, using new concepts of information to screen financial records and analyze financial resources.

Characteristics of the state's population are changing, in part because net migration into the state is continuing. These changes will have many social and economic ramifications. Migration and birthrate trends will create imbalances in future age distribution as segments of state population simultaneously grow older and younger. The population over 25 years and less than 15 years of age will increase while substantial declines in the 15 to 24 age bracket will occur. This means additional and different types of services will be required for much of the state's population. Services for those 15-24 will be under-utilized, but that same age group will be called on to contribute more to the economy.

An examination showed a definite relationship between part-time farming and off-farm employment opportunities. Entry into part-time farming, the study showed, is made easier when abundant off-farm job opportunities existed. But in areas where non-farm employment decreased, so did the number of part-time farms.

The changing structure of the state's agriculture since 1959 was investigated, using data from the Census of Agriculture and a recent Clemson University survey of farm operators. Agriculture production, the survey showed, is becoming increasingly concentrated into small numbers of producers. Nevertheless the ratio of small operators (sales under \$5,000 per year) to very large operators (those with sales over \$100,000 per year) is five to one. The state has maintained its share of elderly and part-time farmers and increased its so-called "hobby" farm operators.

Another comprehensive survey to pinpoint the current financial condition of the state's agriculture indicated that nearly 20 percent of the state's farmers are financially stressed; major crop farms are experiencing the most difficulty; and many large, family, commercial farms are worse off than smaller operations partially supported from off-farm income.

Tobacco policy research revealed that nearly 3 million pounds of flue-cured tobacco quota were purchased in South Carolina since passage of the No Net Cost Tobacco Program Act of 1982. The average price paid for quota was \$1.75 per pound. Beef forage studies suggested that year-round grazing systems producing finished beef are possible in the Piedmont. A model was developed to simulate the financial performance of a 620-acre corn, soybean and tobacco farm in the Coastal Plains under alternative economic scenarios and debt-to-asset ratios. Under the current economic scenario, farms with debt-to-asset ratios of 40 percent or greater produced a negative cash flow.

Marketing research focused on vegetables as possible optional crops for more traditional agricultural enterprises in South Carolina and the entire Southeast. Consumption trends of these vegetables in potential markets and effects of expanded vegetable production on profitability were explored. South Carolina households were surveyed for a profile of pick-your-own customers.

Other marketing research examined the potential for producers to increase returns and/or induce risks from alternative marketing strategies (including participation in government programs, options trading, hedging and forward contracting) for cotton, soybeans, corn and small grains. Peach marketing research dealt with the size distribution of marketable peaches and refinement of shipment forecasts provided in a weekly newsletter from the department. Livestock research has focused on the comparative advantages and disadvantages experienced by South Carolina feeder cattle and broiler producers.

### Agricultural Engineering

Agricultural engineers have been involved in a wide range of research projects to improve the food and fiber production in American agriculture with a concern for the environment and farm profitability.

The primary research areas are power and machinery, farm structures and environment, waste management, fruit and vegetable mechanization, soil and water, electrical power and processing, and aquaculture. Four of some 45 projects are highlighted here.

Grain drying requires heat to remove water. Heat requires energy, which is costly, so the lowest cost drying process is needed. Many methods of drying have been used, including solar, wood and natural gas. A project at Clemson used a heat pump, a standard method of heating and cooling homes, which was designed with the evaporator coil being in the exit air of the grain dryer. This arrangement made it possible to condense the moisture from the exhaust air and pump the resulting heat to the entering air stream. Several variables (moisture, load addition rate, air flow rate and air temperature) could be controlled to measure the coefficient of operation (COP). The higher the COP, the more efficient and cheaper the operation will be. The COP for the heat pump decreased as operating temperature increased and increased as the mass air flow rate decreased.

Aquaculture is an emerging industry in South Carolina. Production has grown to several hundred acres of shrimp, crawfish and catfish with several thousand acres planned. State farmers interested in



fish as an alternative crop are requesting assistance.

To provide information to potential producers, a project was started at Clemson Bottoms consisting of 30 ponds of a tenth-acre each and two large ponds of less than an acre. Each pond can be filled or drained by gravity flow. A building houses four 1,500-gallon tanks for holding fish for processing or data collection. This facility will be used to develop technology for small farm operations trying to use existing ponds and surface water sources. Current research is evaluating aerator design, cage design, sheltered feeding areas for small fish and aquatic weed control.

The effect of different tillage systems on erosion is being studied on small plots double cropped with wheat and soybeans on a Cecil Sandy loam soil in the Piedmont. All plots are chiseled and disked in the fall before planting wheat with a conventional grain drill. After wheat harvest in June, three different tillage systems are used to establish the soybean crop. Three plots are bottom plowed and disked lightly; three are chisel plowed and disked; and the third set of three plots receives no tillage prior to planting. Runoff from each plot is measured throughout the year, and samples are analyzed for concentrations of sediment, nitrogen, phosphorous, potassium and pH. The measured data for these events were compared with data predicted by a computer model called SEWDIMOT II. Both measured and modeled erosion amounts were greatest from the disk-chisel plots and least from the no-till plots.

A successful prototype interseeding machine has been developed that plants wheat in 15-inch rows and then later interseeds soybeans between the rows of wheat prior to harvest. The proposed planting system would eliminate costly tillage practices for soybeans while requiring lower horsepower tractors. Energy and soil conservation are important overall benefits of the system.

The new method also allows soybean planting in late April or early May when soil moisture is usually more ideal for obtaining optimum stands than in mid to late June after wheat harvest.

### Agronomy and Soils

The Agronomy and Soils Department conducts research directed toward the most efficient use of soil resources for agricultural production and preservation of environmental quality. It also conducts research in management of agronomic cropping systems and in development of new crop varieties.

As more intense crop management procedures are adapted and pressures increase to achieve higher levels of productivity, use of pesticides, fertilizers and other agricultural chemicals will present ever-increasing environmental problems. Research relating to the persistence, effective lifetime in soils and migration will help to establish the most practical and efficient management of these chemicals.

In the Southeast, accelerated biological decomposition decreases pesticide effectiveness; low soil retention characteristics and high leaching losses present the potential for groundwater contamination.

Research in soil biological processes, water movement and soil classification studies under way will contribute to more economical use of chemicals as well as reduce the amounts which contaminate the environment outside the agro-ecosystem.

Other research is directed toward improving the competitive position of plants in extracting water and nutrients from subsoils that are acidic and restrictive to root development. The work focuses on the strategic placement of fertilizer nutrients and exploiting the physiological ability some plants have to penetrate subsoils.

A major joint research program in improving soybean germplasm through conventional crossing and selection through genetic manipulation is under way. The work is a joint effort of this department, the Department of Plant Pathology and Physiology and the faculty of the College of Sciences. Several approaches are being followed concurrently, including improved resistance to cyst nematode and insects, increasing nitrogen fixation capacity and superior root development characteristics.

#### Animal Science

Both the boar and bull test stations at Clemson, Pontiac and Edisto Research and Education Center near Blackville continue to play significant genetic, educational and public relations roles. Producer satisfaction keeps prospective buyers returning year after year. Genetically superior males have demonstrated their ability to sire faster-growing, quality offspring which consume less feed per pound of gain.

Last fall the performance of the tested boars was 2.22 pounds of gain per day with an overall feed conversion of 2.28. This performance level was greater than that of any previous group. One pen of Yorkshire boars had a feed conversion of 1.98 pounds. The top selling boar from the pen went to Swine Genetics International, Cambridge, IA.

Bull performance at Clemson and Edisto continues to climb. The average daily gain was 3.27 and 2.73 respectively. Gains at Edisto are less due to the grazing program. The 365-day weights at Clemson averaged 1,150 pounds and 1,320 pounds at 452 days at Edisto. The highest selling bull at Edisto, a Charolais at \$6,500, went to Skymont Charolais of Billings, Mont. Both stations have sold bulls out of state, and there appears to be a trend toward selling some of the gainleaders to more distant places.

A number of these sires are sold by telephone and video. One challenge ahead is how to sell: auction as usual, telephone conference hookups, and locations in the state with conference and video linkups.

#### Aquaculture, Fisheries and Wildlife

In cooperation with the S.C. Wildlife and Marine Resources Department, the effects of varying fertilization regimes on water quality, zooplankton production, and growth and survival of larval striped bass were investigated at Dennis Wildlife Center in Bonneau.



Greater fluctuations in water temperature, dissolved oxygen and pH were observed in ponds that received highest amounts of organic nitrogen fertilizer. Treatment with dylox to control fairy shrimp drastically reduced zooplankton abundance. Only rotifers of the zooplankton community increased in abundance after dylox treatment. Striped bass size varied significantly with percent survival, which ranged from 21 to 84 percent. Best survival was observed in ponds that received an intermediate fertilizer rate.

Thermal preference of striped bass in lakes Moultrie and Marion was studied by outfitting these fish with temperature-sensitive radio transmitters. Generally, striped bass did not utilize waters warmer than 29 degrees Centigrade, seeking refuge in small pockets of cooler (26C) water during July and August.

In cooperation with the Wildlife and Marine Resources Department and the Savannah River Ecology Laboratory, this department initiated a study of fawn white-tailed deer home range and movement behavior at Webb Wildlife Center and Management Area in January 1986. Eighty-four deer of all ages were captured in drop nets, cannon nets and corral traps. Twenty fawns nine to 10 months old were fitted with radio transmitters. The other 64 deer of all ages were ear tagged. Webb deer are active from just before dusk until just after dawn and use an area ranging in size from one to 1.5 square kilometers. One female deer left Webb Center and established a new range three kilometers away on an adjacent property. Another female made a similar long distance movement but returned to Webb Center after four to five days. No males have made such long movements. Dispersal by females contradicts the consensus that yearling males are the primary dispersers in a deer population.

#### Dairy Science

Dairy scientists are exploring a wide variety of subjects important for both production and processing aspects of the industry. Lactational response to alternative forage sources is one such research area. Thirty-six Holstein cows were fed total mixed rations in which either corn, rye, sorghum or wheat silage served as the forage component. Cows averaged 85 days in lactation at the start of the 12-week study. Forages were grown and harvested according to standard practices and stored in upright silos. Cows fed the sorghum silage total mixed ration consumed more dry matter and produced more four-percent fat-corrected milk than cows fed either the rye or wheat silage total mixed rations. This adds support to previous research indicating that forage sorghum is a good alternative to corn silage for lactating dairy cows.

Embryo transfer has become an important tool in husbandry practices with domestic farm species. The ability to synchronize the developmental stage of the embryo to the endometrial stage of a recipient cow that is not synchronous with the donor could be of economic benefit to the producer. Very low levels of electrical current were used in attempts to stimulate growth of embryos in the laboratory. Seven microamps of electrical current, a current density

as low as possible in our system, did not benefit embryo growth. Current densities of 15 microamps or greater were detrimental, causing the cells of the embryo to fuse or become compacted, both resulting in death of the embryos.

The prevention of light-induced off-flavor and nutrient degradation of dairy products is another research subject. The translucent plastic disposable jugs currently used in the dairy industry do not amply protect milk from effects of light. A preliminary study investigated the use of oriented polypropylene and aluminum foil labels on preventing light-induced off-flavor and riboflavin (vitamin B<sub>2</sub>) loss in milk. Milk was processed and packaged in half-gallon polyethylene containers. Results suggest that labels placed around the lower half of the half-gallon containers were effective in reducing light-induced off-flavor and riboflavin loss. Labels also serve as advertisements, which can further benefit the industry.

### Entomology

Clemson entomologists have been looking at a variety of different pests plaguing consumers and farmers, including the common cockroach, the Formosan termite and corn earworm. Learning more about these pests and ways to control them continues to claim the interest of department researchers.

The German cockroach, a pest common to homes, businesses and other settings, is becoming increasingly resistant to insecticides. This resistance often is not detected until after treatment, which is costly in terms of application time and chemical costs, especially in large office complexes or housing facilities where several days or months of treatment may be completed before poor control is noticed.

A new resistance testing procedure has been developed to allow professional pest control operators to test a random sample of their cockroach population for resistance before treatment takes place. This permits selection of an insecticide which will be most effective. The test procedure is simple, cheap and accurate, and validation tests are being carried out in a housing facility. Research is also being carried out on the Formosan subterranean termite (FST), which is rapidly becoming one of the most economically important insect pests in South Carolina. The termite inflicted an estimated \$76 million in damages in Florida, Louisiana and South Carolina in 1983. The city of New Orleans spent \$200,000 in a 10-year period replacing utility poles damaged by the termite. Preliminary data indicate that existing infestations will cause similar damage in Charleston.

One of the major problems surrounding this pest is that detection is often difficult until after major structural damage has occurred. Current research centers on the range of the species in South Carolina and early detection procedures. Detailed random sampling data, year-round light trap data and a review of pest control company records on infestations are being analyzed and interpreted.

The corn earworm is one of the major insect pests attacking field crops in the Southeast, but relatively little is known about its population dynamics and the way adult population movement patterns



influence crop infestation by destructive larvae. Both of these aspects of its ecology are important to the development of effective management strategies for this pest.

The corn earworm, Heliothis zea, is a generalist feeder attacking most agronomic crops produced in the Southeast. Depending on environmental conditions, it may undergo four to six generations per year with adults dispersing into various crops as they begin flowering and fruiting. The larvae that hatch from the eggs deposited by these adults then feed on the reproductive and fruiting structures of various crops. During 1984-85, studies were undertaken to examine the local movement patterns of adult corn earworm moths. To tag naturally occurring populations, feeding stations were developed. Moths were tagged as they emerged following larval development in either whorl- or ear-stage field corn. These new adults would be dispersing to ear-stage corn and cotton respectively. Dispersing adults were collected using pheromone traps set up in concentric rings around the tagging site. Analysis of the data from within one kilometer of the tagging site indicates that local movement of adults is predominantly random; however, there does appear to be some influence on movement due to nocturnal wind patterns.

Beginning with the 1986 growing season, the emphasis of the project has been shifted to larval populations. Within an area of approximately 250 ha, all crops are being monitored as they become attractive to the earworm adults. This study's objectives are to develop an area-wide life table for the corn earworm, and to examine the feasibility of an area-wide management approach for the earworm in the Southeast.

Additional studies have examined the spatial pattern of both corn earworm larvae and two of the common parasitoids attacking the larvae during the whorl-corn generations. Previous studies have indicated that the whorl- and ear-corn generations are where biological controls will need to be applied to reduce pesticide use on subsequent highvalue crops such as cotton and peanuts.

#### Food Science

The use of new technology/biotechnology to enhance food product and process development has resulted in significant innovations. Of special note was the application of metallic membrane technology to fabricate and evaluate a scale-up version of the single pass ultra-filtration process for apple juice, resulting in higher yields and greater operational ease. Studies also demonstrated that the membrane system could be steam-sterilized, which permitted juice to be packaged aseptically, making practical the production of commercially sterilized apple juice. Additional commodities, including grapes, muscadines, kiwi, pineapple (skins and pulp), peaches, pears, celery and carrots were evaluated and demonstrated to be viable products from which juice could be prepared using the metallic membrane process.

Significant strides were also made in the application of biotechnology in the tissue culture of tea (Camellia sinensis). Bud culture and embryo culture were accomplished, but possibly more

important was development of a novel method of sterilizing explant tissue for callus culture. Additionally, studies of some 100 species of freshwater algae were screened, and at least five candidates (species) were identified that exhibited the capacity to produce highly viscous mucilages (i.e., gums). Such compounds have promising solubility and stability characteristics making them potentially useful as thickeners and stabilizers in processed foods. Further biotechnology studies with mutant species of Escherichia coli demonstrated that valine, leucine, isoleucine, phenylalanine, alanine, tyrosine and aspartate were produced in large quantities when appropriate precursors were added to media. The data suggest that genetic material can be channeled to over-produce selected amino acids.

Studies to ascertain the bioavailability of nutrients in food-stuffs indicated that the addition of rice bran, oat bran, soft wheat, orchard wheat brans, corn bran or cellulose to breads at levels up to 5.2 percent had no measurable effect on the digestibility of protein. Animal trials suggested a significant beneficial effect of hard wheat bran on protein utilization, whereas the other brans studied were without effect. Thus the inclusion of dietary fiber in breads appears to be without adverse effect on protein utilization. In studies involving nine wheat-based, ready-to-eat breakfast cereals, the methods of processing markedly affected the protein breakfast cereals. For flaked and extruded cereal products, the percent of total lysine available did not differ, but was substantially higher than for cereals that were processed by puffing. The digestibility of the protein in puffed process cereal also was less than in cereals processed by other methods.

#### Home Economics

A survey on protective clothing farmers wear when they spray pesticides in their fields, how the clothing is cleaned and attitudes toward it was carried out by researchers at Winthrop College's School of Consumer Science and Allied Professions and colleagues at the University of North Carolina-Greensboro. The research was a joint Southern Regional Research Project (S-163) entitled "Effects of Functional Finishes on Comfort and Protection of Consumers."

Farmers in North Carolina and South Carolina were questioned in 1985 to gather personal information and to collect data on use of pesticides, protective clothing worn during pesticide use and methods of cleaning clothing exposed to pesticides.

The survey found that most of the farmers were either approaching or past middle age and were fairly well educated. A third of the farmers in both states were 36 to 49 years old, and just over half were 50 or older. Twice as many South Carolina as North Carolina participants had four-year college degrees, although 24 percent of the Tarheel growers had from one to three years of college. Educational levels of farmers indicated a knowledgeable audience, but one perhaps less strong in their belief that protection from pesticides is needed, based on earlier studies.

Handling of clothing contaminated by pesticides varied by state.



In North Carolina, 87 percent of the families contacted tended to remove pesticide from contaminated clothing along with other clothing in the family wash, compared to 21.2 percent in South Carolina. Forty-five percent of the South Carolina families used a separate wash, as compared to 12 percent in North Carolina, but whether separate equipment was used was unclear. Three South Carolina farmers reported using commercial laundries, and 29 percent used disposable clothing.

Data showed further that North Carolina farmers used pesticides fewer days out of the year. The number of days spent applying chemicals would impact the economic decisions of disposable clothing versus washable laundry practices. Wearing protective clothing was a bother to 40 percent of North Carolina farmers while only 15 percent of the South Carolina farmers felt that way. N.C. farmers felt the clothing was not necessary, was too confining and too uncomfortable. Both groups agreed protective clothing was too troublesome, too expensive and that exposure to pesticides was not harmful. However, 81 percent of the South Carolina farmers felt their own work clothing offered enough protection. Preliminary data suggest that different types of protective clothing may be needed, based on farm practices and operations within a given state.

#### Horticulture

Vegetable crops research has produced important new seedless watermelon lines and improved pest-resistant sweet potato varieties at Edisto Research and Education Center. A special CSRS grant has provided support for a tri-state research initiative on alternative vegetable crops for financially distressed farmers in the Southeast. The project is being carried out in North Carolina, South Carolina and Georgia to demonstrate the possibilities of growing various vegetable crops in different climates and conditions. Agricultural economists are cooperating in the project to determine feasibility of vegetable growing and to find possible markets.

An advanced selection from the peach breeding program is being evaluated in commercial orchards. Peach maturity standards have been developed through computer technology and used to improve packing house management and marketing.

Cold-hardiness research has been initiated in kiwifruit and greenhouse crops. New emphasis on greenhouse crops also features research on enhanced environments for more profitable production.

Turf research has produced improved methods for managing seasonal transitions between warm and cool season grasses. Interdisciplinary turf research is developing techniques to forecast disease conditions and to diagnose diseases with genetically engineered indicators.

Additional new research thrusts include post-harvest handling of leafy vegetables and tomato breeding at Coastal Research and Education Center; adapting vegetable crops to new production regions at Pee Dee, Coastal and Sandhill Centers; and peach and woody ornamental root problems at Sandhill and Clemson.

## Plant Pathology and Physiology

Nematode control has become much more difficult because of the loss of some of the more efficient nematicides and the ever-changing nematode populations. In response, the Department of Plant Pathology and Physiology has been stressing research on alternative methods of nematode control.

A strain of the peanut root-knot nematode, Meloidogyne arenaria-2, is increasing in importance across the Coastal Plains. Unlike the southern root-knot nematode, there is very little host resistance in the main crops such as soybeans, cotton and tobacco to race 2 of the peanut root-knot nematode. As a rule, it is more damaging than the southern root-knot nematode.

In a rotation experiment, race 2 of the peanut root-knot nematode increased on tobacco and soybeans but were much lower where corn and grain sorghum were grown. In the absence of other means of control, it is recommended that non-host rotations be considered. Corn and sorghum also are resistant to the soybean cyst nematode. Where they can be included in rotations, they help prevent the build-up of cyst nematodes.

Concurrently with cultural means of control, testing and breeding for resistance to the major nematodes in South Carolina has been emphasized. Twenty soybean cultivars from V and VI and 28 from groups VII and VIII were field tested for tolerance to the Columbia lance nematode, Hoplolaimus columbus. Several cultivars exhibited acceptable tolerances. Of the cultivars tested against the soybean cyst nematode and the southern root-knot nematode, the cultivars Coker 485, FFR 562, LeFlore, Centennial, Ring Around 702 and Gordon showed the most promise. To enhance the soybean breeding program, a rapid greenhouse screen was established which will significantly reduce the time it takes to detect resistance in both plant introductions and local breeding material.

Ring nematode on peach trees presents another kind of resistance problem. Peaches are perennial plants, and nematode damage does not become apparent until the trees have been growing for three or four years. About 130 Prunus lines are being field tested for tolerance to ring nematodes. Concurrently new ways of testing are being developed. Seedlings are being grown in a greenhouse and inoculated with known numbers of ring nematodes. Susceptibility and resistance will be evaluated by visual inspection of roots. Small trees are being grown in bottles, and a system of introducing "clean" nematodes is being developed.

Some of the soil pesticides that can be used against nematodes tend to lose effectiveness when used repeatedly in the same soils. In soils with a previous history of carbofuran use, carbofuran was completely lost for 15 days. In soils where carbofuran had not been used, the pesticide remained active with no breakdown for 15 days. It is believed that South Carolina soils contain microorganisms that metabolize carbofuran and render it ineffective a short time after application. Other pesticides probably react similarly. These results help explain why some pesticides give erratic results.



## Poultry Science

The immune status of chickens and turkeys is increasingly determined by the enzyme-linked immunosorbent assay (ELISA). This technique is highly sensitive, but it may detect antibodies that have no relationship to disease resistance. Clemson poultry researchers investigated the blood serum fractions that correlate with survival from deliberate infections of the deadly forms of fowl cholera. Antigens prepared from cholera-causing bacteria in seven different methods all gave positive tests for the presence of antibodies against fowl cholera in vaccinated broiler breeders. Only two of these treatments, potassium thiocyanate extracted and capsular, correlated well with data on survival to challenge. These data show that for reliable immunity tests, antigens must be tested for their correlation with disease resistance and that high titers from untested antigens may give erroneous immune information.

Chicken and turkey hens have the ability to store sperm from a single insemination for a period of weeks although individuals and flocks vary in fertility following insemination. The mechanism by which sperm enter the sperm storage glands of the hen has been studied at Clemson. The objective of this work is to find methods of improving fertility through greater sperm storage in the hens' oviduct. Maintenance of tissue from the hens' reproductive tract in test tubes has allowed close observation of sperm movement into the storage glands after introduction of semen into the system. This work shows that sperm of the same species find their way into the glands within 15 minutes. Sperm from bulls will be stored in chicken glands, but they migrate more slowly. This suggests that some recognition system exists within the sperm storage glands.

South Carolina has some of the largest gourmet poultry products producers in the country. Quail and squab grown and processed in the state are distributed throughout the nation. Comparatively little research, however, has been done on the nutrient and microbiological quality of these products. Recently poultry scientists initiated studies on these two aspects of squab meat. Nutrient composition of squab shows they are lower in moisture and higher in fat than chicken fryers, and are more like turkeys than chickens in nutrient value. Studies show that the squab carcasses become increasingly free of microorganisms as the birds move through the processing plant. Organisms associated with the digestive tract are most numerous in the killing room and are progressively reduced through the processing plant. Salmonella were isolated at the beginning of processing, but none was isolated after the final carcass rinsing. These results suggest that processing of the minor species, in which specialized equipment and techniques are used, still results in a wholesome and nutritious product.

## Branch Research and Education Centers

The S.C. Agricultural Experiment Station's four branch research centers continue to stress the specialties of the areas where they are located.

The Sandhill Center at Pontiac focuses on fruit, nut tree and vegetable research. The S.C. Swine Evaluation Center and Livestock-Poultry Health Division are located at Sandhill.

The Pee Dee Center near Florence continues to expand crop research on tobacco, soybeans, corn, cotton and vegetables at a new \$4 million complex completed and dedicated in summer 1985. Studies of aquaculture are also planned at the 2,300-acre experiment center. Center personnel breed plant varieties for resistance to diseases, insects, frost and drought, and develop better cultivation methods and machinery for harvesting. Pee Dee Center scientists have been responsible for several research developments that brought international acclaim to the center.

The Coastal Center at Charleston furnishes data to the Extension Service for work with vegetable growers in the Coastal Plains. Ornamental research is conducted at the facility, and a large urban research and demonstration area on Highway 76 South provides information to school classes, garden clubs and homeowners concerning flowers, herbs, shade trees, lawn grasses, vegetables and other plants.

The Edisto Center at Blackville designs research for growers and cattle producers in the Upper Coastal Plains. Field crops such as corn, soybeans, small grains, melons and sweet potatoes are studied, along with forage/beef cattle systems.

#### Active Research Projects 1985-86

##### Agricultural Economics and Rural Sociology

An economic analysis of alternative marketing strategies for cotton producers.

Economics of horticultural crop production in South Carolina.

Impact of changing costs, institutions and technology on the Southern dairy industries.

Improving community services in non-metropolitan counties in the South.

U.S. food demand and consumption behavior.

Local impacts of economic demographic change in South Carolina.

Structural and operational efficiency of the fruit and vegetable production-marketing system.

An economic analysis of risk management strategies for agricultural production firms.

Economics of improving productivity in the livestock-meat systems in the South.

Labor markets and labor force differentiation in non-metropolitan areas.

Disturbances to price discovery-risk management by marketing firms in southern agriculture.

Economic analysis of the impact of alternative flue-cured tobacco programs.

Monetary, fiscal and trade policy impacts on farm organization.

Socioeconomic dimensions of technological changes, natural resource use and agriculture structure.



Organization and operation of South Carolina water utility systems.  
Growth of the South Carolina broiler industry relative to other  
Southeastern states and the United States.  
Agricultural adjustment in the Southeast through alternative cropping  
systems.  
Production and marketing of catfish and crawfish in South Carolina.  
Marketing strategies for agronomic crops with uncertain prices and  
yields.  
Agricultural water use and irrigation profitability in South Carolina.  
Economic analysis for coastal resources management and policy.  
Consumption of and market potential for catfish and crawfish in S.C.  
Demographic data analysis and policy implications.

#### Agricultural Engineering

Soybean production simulation models.  
Optimize production efficiency of animal housing systems in the  
Southern region.  
Energy reduction for crop production systems.  
Control systems for optimizing tractor energy and fuel consumption.  
Energy reduction for crop production systems.  
Effects, mechanisms and control of erosion and sediment from  
agricultural and forested lands.  
Agricultural meteorology and climatology for production in the  
Southern region.  
Effect of swine lagoon effluent on hardwood seedling growth.  
Methane production potential from farm crops.  
Factors contributing to and control of peach tree short life in S.C.  
Improving tobacco bulk curing systems.  
Processing and storage of southern agricultural commodities.  
Engineering and management systems for cotton production, harvesting  
and processing.  
Engineering analysis and design for aquaculture catfish, crawfish and  
clams.  
Animal waste as nutrient and energy resources in warm, humid  
climates.  
Automatic monitoring and controlling grain storage.  
Remote sensing and sensor development for tree fruit production and  
harvesting.

#### Agronomy and Soils

Significance and distribution of mineral components in Southern  
soils.  
Grain yields and field performance of barley, oats, rye and wheat.  
Advanced strains and cultivars of cotton, soybeans and peanuts.  
Soybean response to irrigation, plant populations and related  
management practices.  
Soil fertility management for irrigated corn and soybeans.  
Evaluation, establishment and management of forage legumes and legume  
grass combinations.

Cytological and developmental studies of soybean and clover hybrids.  
 Nitrogen source for production of forages.  
 Development of improved soybean varieties.  
 Breeding cotton for improved yield, fiber quality and resistance to insects.  
 Weed control in corn, cotton and soybeans.  
 Overcoming factors limiting biological dinitrogen fixation by leguminous plants.  
 Cellular and molecular genetics for crop improvement.  
 Chemistry of atmospheric deposition: effects on agriculture, forestry, surface waters and materials.  
 Breeding disease and nematode resistant flue-cured tobacco for yield, quality and harvestability.  
 Heat-drought tolerance of white clover stolon meristems.  
 Life history, population dynamics and interference: a basis for understanding weed biology.  
 Small grain breeding and genetics.  
 Spatial and temporal variability of soil characteristics and material fluxes in field soils.  
 Influence of various tillage and cropping systems on integrated pest management in soybeans.  
 Cultural practices and variety development for flue-cured tobacco.  
 Rhizobia and mycorrhizae to enhance BNF in cowpeas.  
 Growth and nutrient uptake by soybean roots as affected by cultivars and soil properties.  
 Bacterial extrachromosomal factors controlling Rhizobium japonicum soybean symbiosis.  
 Genetic mechanisms for soybean germplasm development. Breeding cool season for forage grasses.  
 Modifying aluminum toxicity for plants in acid soils.  
 Nitrogen and phosphorus starter fertilizer rates and ratios on well fertilized soils.  
 Agronomic evaluation of quality forages in the South Carolina Coastal Plain.  
 Field corn and grain sorghum cultivars for grain production.  
 Establishment and management of forage crops under stresses of environment and biotic origin.

#### Animal Science

Breeding methods for beef cattle in the Southern region.  
 Marketability and acceptability of beef produced under forage-grain management systems.  
 Nutrition and management of swine for increased reproductive efficiency.  
 Utilization of forages for production of slaughter cattle throughout the year.  
 Estimation of pork muscle growth and evaluation of hot processing and chlorine washing for hams.  
 Effect of gender and feed intake on growth and serum hormones and metabolites of the bovine.



Improving reproductive efficiency of cattle and swine.  
Efficacy of starter diets for early weaned pigs.

#### Consumer Science and Allied Professions (Winthrop College)

Effects of functional textile finishes on comfort and protection of consumers.

#### Dairy Science

Influence of ration composition on plasma hormones and lipid metabolism in dairy cows.  
Effects of environmental and management stressors on production and reproduction in dairy cattle.  
Metabolism, toxicokinetics and physiological effects of aflatoxin B in the bovine.  
Effects of media, culture and storage on survival of cattle and sheep embryos.  
Protein nutrients for ruminants.  
Preventing light induced off-flavor in dairy products.  
Development of cold pack and process blue cheese.  
Iodine concentrations in milk and milk products.  
Metabolic and production response of dairy cattle fed forage-based diets.  
Dietary factors affecting the toxic and immune response of ruminants to mycotoxins.

#### Aquaculture, Fisheries and Wildlife

Feral swine movement, habitat utilization and pig survival.  
Warm water aquaculture.  
Dynamics of harvesting a South Carolina coastal plain deer herd.  
Home range size, movement behavior and territoriality in the beaver.  
Home range and habitat use of fox squirrels in the Coastal Plain of South Carolina.  
Movement behavior of gray fox and scent station transects validation.  
Thermal habitat selection by striped bass in Santee-Cooper.  
Biology of clams, whelks and other important shellfish.

#### Entomology

Biology and control of arthropods affecting man and animals.  
Biological control of insect pests of soybeans.  
Entomopathogens for use in pest management systems.  
Physiological relationships between insects and biological control agents.  
Comprehensive, unified, economically and environmentally sound systems of integrated pest management for soybeans.  
Identification and distribution of insects of potential importance in South Carolina.  
Biology and control of arthropod pests on apples.

Endemic and imported natural enemies in management of soybean and insect pests.  
 Integrated management strategies for insect pests of forage crops and feed grains.  
 Tactics for management of soybean pest complexes.  
Heliothis spp: management systems for field crops.  
 Bionomics and control of insects on cotton.  
 Improved systems of management for pecan arthropod pests.  
 Bionomics and ecology of Heliothis zea and H. virescens on cultivated and wild hosts.  
 Biology, ecology and control of domiciliary cockroaches.  
 Bionomics and control of the European corn borer.  
 Insecticide resistance in insect pests and their predators in cotton, corn, soybeans and tobacco.  
 Breeding soybeans for resistance to insect and nematode pests.  
 Biology and control of imported fire ant.  
 Biotypes of Heliothis zea in South Carolina.  
 Synanthropic diptera, ectoparasites, and other associated pests of poultry.  
 Economic management of tobacco insect pests.  
 Population dynamics and management of peach arthropods.  
 Impact of integrated crop management practices on European corn borer and related stalk boring insects.

#### Food Science

Function, nutrient composition, quality, stability and efficient production of poultry products.  
 Functional properties of proteins.  
 Microbiological and process factors affecting quality of fermented sausage.  
 Maximizing the use, nutritive quality and consumer acceptance of sweet potatoes and their products.  
 An energy audit of laboratory animals using a modified whole body calorimeter.  
 Water hardness and lipid metabolism.  
 Optimization of thermal processes for conduction-heated foods in retortable pouches.  
 Dietary fiber effects on protein quality.  
 Analysis and interpretation of selected South Carolina nutrition survey data.  
 Interrelationships of diet and physical activity in hypertension.  
 Processing foods by metallic membrane ultrafiltration and hyperfiltration.  
 Shelf-life and quality of individually shrink-wrapped fruits and vegetables.  
 Urinary metabolites of pyridoxine intoxication in the rat.  
 Dietary carbohydrates and aberrations in lipid metabolism.  
 Plasmid and genetic transfer systems in lactobacilli.  
 Protein and mineral bioavailability from food products.  
 Dietary zinc and changes in bone composition.



## Horticulture

Plant germplasm -- its introduction, maintenance and evaluation.  
Breeding edible Southern peas with resistance to insects and disease.  
Breeding and evaluation of watermelon and cantaloupe varieties.  
Turfgrass culture and improvement.  
Cultural and management practices of pecans.  
Vegetable breeding: developing improved cultivars and germplasm.  
Breeding improved stone fruit scion and rootstock cultivar.  
Potential new crops and multiple-cropping schemes for vegetable production systems.  
Irrigation and fertilization systems for vegetable production.  
Cultural and environmental effects on strawberry.  
Environmental and biological stresses of rootstocks in peach tree longevity.  
Assessment of progress in breeding for soil-pest resistance in sweet potatoes.  
Orchard ground cover management systems for peaches.  
Trickle irrigation in humid regions.  
Evaluation of herbicides to support registration on vegetable crops.  
Chilling injury of selected greenhouse plants.  
Photosynthesis, carbohydrate distribution and growth in peach trees.  
Alteration of stone fruit metabolism.  
In vitro propagation, hybridization and selection schemes for the improvement of cucurbits and sweet potatoes.  
Tomato germplasm and cultivar development.  
Breeding and development of multiline varieties of pickling cucumbers.  
Breeding and evaluating sweet potatoes for food and industrial uses.  
Nitrogen and water application practices for ornamentals and turfgrasses.  
Quality maintenance and improvement of fresh market peaches and apples.

## Plant Pathology and Physiology

Forage legume viruses.  
Methodology, dissipation and fate of pesticide residue in agricultural ecosystems.  
Variability of root-knot and cyst nematodes and factors influencing their population dynamics.  
Etiology, epidemiology and control of pecan diseases.  
Causes and control of diseases of cereal grains in South Carolina.  
Causes and control of diseases of ornamental plants.  
Physiological responses of plant tissue and cell cultures to plant growth regulators.  
A physiological approach to peach tree short life.  
Etiology and control of tree fruit pathogens.  
Mycotoxins of corn and other feed grains.  
Distribution, ecology and pathogenicity of ectoparasitic nematodes of soybeans.

Biology and control of viruses and mycoplasmas in corn and sorghum diseases.  
 Biological control of weeds with fungal plant pathogens.  
 Etiology and control of fungal and viral diseases of vegetables.  
 Etiology and control of plant diseases of ornamental plants.  
 Suppression of aflatoxin and nematodes in corn through cultural practices.  
 Tobacco diseases and nematode control.  
 Biology and management of selected soybean diseases.  
 Disease control of cucurbits and tomatoes.  
 Factors contributing to and control of peach tree short life in South Carolina.  
 Biological and chemical control for nematodes and diseases of peach and apple trees.

#### Poultry Science

Function, nutritive composition, quality, stability and efficient production of poultry products.  
 Preserving turkey and chicken semen, and factors affecting semen production in turkeys.  
 Web wing vaccination of turkey breeders with an avirulent Pasteurella multocida.  
 Fowl cholera immunity in breeder chickens determined by the enzyme linked immunosorbent assay. Control of food and water intake in poultry.  
 Dietary factors affecting chole-calciferol metabolism in poultry.  
 Natural and processed ingredient influence on production of poultry.  
 Live mutant Pasteurella multocida vaccine for prevention of fowl cholera in turkeys.  
 Nutritional and hormonal factors influencing structure and quality of eggshells.  
 Monitoring fowl cholera immunity in turkeys.  
 Factors affecting the ability of the hen to sequester sperm.

#### Departmental Research Series

AE 437 South Carolina Livestock and Poultry Statistics. S.C. Crop and Livestock Reporting Service.  
 AE 438 South Carolina Cash Receipts from Farm Marketings. S.C. Crop and Livestock Reporting Service.  
 AE 439 1985 Vegetable Statistics. S.C. Livestock and Crop Reporting Service.  
 RR 85-1 Agricultural Options: An Alternative to Current Agricultural Programs. Kandice H. Kahl.  
 RS 107 Performance of Sunflower Hybrids in South Carolina -- 1985. Agronomy and Soils.



## Technical Contributions

- 2444--The Larva of Ochrotrichia arizonica (Trichoptera:Hydroiptilidae) with Notes on Distribution and Geographic Variation by William R. English and Steven W. Hamilton.
- 2445--Grafting Camellias by Luther W. Baxter Jr. and Susan G. Fagan.
- 2446--Phytophthora Root Rot and Stem Canker of Peach Trees in Mississippi by Robert A. Haygood, Clinton H. Graves and William H. Ridings.
- 2447--Variability in Growth of Hard Clams, Meremaria Mercenaria, with Reference to Selection Protocols for Mariculture Purposes by A.G. Eversole, L.W. Grimes and P.J. Eldridge.
- 2448--A Preliminary Report on a Method for More Control of Camellia Dieback and Canker by Luther W. Baxter Jr. and Susan G. Fagan.
- 2449--Effects of Pest Resistant and Susceptible Soybeans on the Development of Geocoris punctipes (Say) (Hemiptera: Lygaeidae) by D.J. Rogers and M.J. Sullivan.
- 2450--Evaluation of Thermal Processing of Retortable Pouch Filled with Conduction Heated Foods Considering Its Actual Shape by Shweta Tandon and Santi R. Bhowmik.
- 2451--Two New Species of Caddisflies from Georgia (Trichoptera: Polycentropodidae, Hydroptilidae) by Steven W. Hamilton and Ralph W. Holzenthal.
- 2452--A Comparative Study of Methods for the Determination of Reactive Aluminum by Steven C. Hodges.
- 2453--Sensory Properties of Potato Chips Prepared from Several Sweet Potato Cultivars by G.P. Burch, R.L. Thomas, M. G. Hamilton and E.S. Halpin.
- 2454--Inefficacy of Propionic Acid for Depleting Laying Hens and Their Progency of Vitamin B12 by N.E. Ward, J.E. Jones and D.V. Maurice.
- 2455--Effect of Oxygen Transmission Rate of Packaging Films on Color Stability of Vacuum Packaged Chicken Bologna by J.C. Acton, L.B. Ferguson and R.L. Dick.
- 2457--Water Absorbent Aids in the Inoculation of Field Sites with Meloidogyne Eggs by B.A. Fortnum, R.E. Currin III and J.P. Krausz.
- 2458--Lack of Reproduction of Paracriconea n. sp. and Nothocricone mella mutabilis on Prunus persica by R.C. Owings and D.W. Cain.
- 2459--Variations in Rates of Increase Among Cricone mella xenoplax Populations on Prunus persica cv. Nemaguard Seedlings by R.C. Owings and D.W. Cain.
- 2460--Interactions with Hydrolases and the Biochemical Selectivity of Organophosphinates by T.M. Brown.
- 2461--Tagging Heliothis zea (Lepidoptera: Noctuidae) for Local Dispersal Studies Using Rubidium Chloride-Spiked Artificial Nectar by J.D. Culin and D.R. Alverson.
- 2462--The Effect of Benomyl on a Strain of Glomerella Cingulata That Causes Camellia Dieback by Luther W. Baxter Jr. and Susan G. Fagan.
- 2463--Studies in Neotropical Leptoceridae (Trichoptera), VI: Immature Stages of Hudsonema flaminii (Navas) and the Evolution and Historical Biogeography of Hudsonemini (Triplectidinae) by Ralph Holzenthal.

- 2464--Stereoselectivity of Acetylcholinesterase, Arylester Hydrolase and Chymotrypsin Toward 4-Nitrophenyl Alkyl(Phenyl)Phosphinates by John R. Grothusen and Thomas M. Brown.
- 2465--Metabolism of Aspirin and Procaine in Mice Pretreated with 4-Nitrophenyl Methyl(Phenyl)Phosphinate or 4-Nitrophenyl Disphenylphosphinate by James M. Holy and Thomas M. Brown.
- 2466--Improved Estimation of Pathogen Transmission Rates by Group Testing by Peter M. Burrows.
- 2467--The Emergence Pattern of Fuller Rose Beetles, Pantomorus cervinus (Boheman) (Coleoptera: Curculionidae), in a Peach Orchard by Joe Kovach and Clyde S. Gorsuch.
- 2468--Variation in Milk Fat, Protein and Somatic Cell Count from Four Dairy Herd Improvement Laboratories by D.T. Vines, B.F. Jenny, R.E. Wright and L.W. Grimes.
- 2469--A Tool for Assessing Nutrition Education Needs in Industry by M.E. Kunkel.
- 2470--Effects of Weed-Free Period, Row Spacing, and Cultivar on Pitted Morning Glory (Ipomoea lacunosa) Interference with Soybeans (Glycine max) I. Shade Development Patterns by Murdock, Banks and Toler.
- 2471--Effects of Weed-Free Period, Row Spacing, and Cultivar on Pitted Morning Glory (Ipomoea lacunosa) Interference with Soybeans (Glycine max) II. Interface Effects by Murdock, Banks and Toler.
- 2472--Registration of 'Kershaw' Soybean by H.L. Musen, E.R. Shipe, J.D. Maxwell and P.F. Williams Jr.
- 2473--Etiology and Epidemiology of Pecan Downy Spot by W.D. Goff, C.E. Drye and R.W. Miller.
- 2474--Camellia Canker Infected Tissue and Glomerella cingulata as Viewed by SEM by V. Ravichandran and L.W. Baxter Jr.
- 2475--Antigenic Properties of Four Serotypes of Pasteurella Multocida Determined by Enzyme-linked Immunosorbent Assay (Elisa) by A.P. Avakian and J.W. Dick.
- 2476--Response of Two-spotted Spider Mites, Tetranychus urticae Koch to Various Insecticides and Fungicides Used in South Carolina Peach Orchards by Joe Kovach and Clyde Gorsuch.
- 2477--Comparison of HPLC and Glucose Oxidase Assay Systems for Determining Glucose Content of Biomass Samples by Valerie A. Paynter, Debbie Neubauer and Kurt Landenburg.
- 2478--The Effect of Tobacco Thrips Control on Competition Between Large Crabgrass (Digitaria sanguinalis) and Peanuts (Arachis hypogaea) by Murdock, Alden and Toler.
- 2479--Weed Identification Field Training Demonstrations by Murdock, Alden, Gooden and Toler.
- 2480--Nuisance Potential of the Dump Fly Ophyra aenescens Wiedemann Breeding at Poultry Farms by Maxcy P. Nolan III and J.B. Kissam.
- 2481--Effect of BA + GA<sub>4+7</sub>, BA and Daminozide on Growth and Lateral Shoot Development in Peach by Timothy E. Elkner and D.C. Coston.
- 2482--Soils with Bx Horizons in the Upper Coastal Plains of South Carolina by Smith and Callahan.
- 2483--Strip and Broadcast Treatments of 1, 3-D Compared for Controlling Cricanemella xenoplax and Short Life in a Peach Orchard by E.I. Zehr and J.K. Golden.



- 2484--Designing Animal Ventilation Schedules and Counterflow Heat Exchanges by W.H. Allen and F.A. Payne.
- 2485--Separation of Consumption for Maintenance and Gain Among Sex Phenotypes in the Bovine by T.W. Gettys, D.M. Hendricks, P.M. Burrows and B.D. Schanbacher.
- 2486--A Comparison of Three Sampling Devices for Measuring Volatile Organics in Groundwater by Robert E. Gossett and Richard O. Hegg.
- 2487--Managing the Japanese Beetle on Tobacco in South Carolina by Donald G. Manley.
- 2488--Thermal Transitions of Natural Actomyosin from Poultry Breast and Thigh Tissues by J.C. Acton and R.L. Dick.
- 2489--Inoculum Proliferation of Tobacco Mosaic Virus in Tobacco Roots Following Flower Removal Process by J.P. Krausz, B.A. Fortnum and O.W. Barnett.
- 2490--Book Review of Futures Markets: Modelling, Managing and Monitoring Futures Trading, Edited by Manfred E. Streit by Kandice H. Kahl.
- 2491--A Reformulation of the Portfolio Model of Hedging: Comment by Kandice H. Kahl.
- 2492--Growth Responses of Peach Roots and Shoots to Soil and Foliar Applied Paclobutrazol by J.G. Williamson, D.C. Coston and L.W. Grimes.
- 2493--Effect of Energy Intake on Ovarian and Pituitary Hormone Secretion in Postpartum Beef Cows by J.D. Rone, D.M. Henricks, S.E. Echternkamp and C.L. Ferrell.
- 2494--Rate Response of Cotton to Three Pyrethroids by Mary E. Derrick and John A. DuRant.
- 2495--Some Herbaceous Hosts of Criconemella xenoplax (Nematoda: Criconematidae) by E.I. Zehr, S.A. Lewis and M.J. Bonner.
- 2496--Alrenogest Gonadotropin Effects in SLA Miniature Swine by J.R. Diehl.
- 2497--Influence of Row Spacing and Seeding Rate on Alfalfa by Holliday and Rice.
- 2498--Centipede Grass Tolerance to Single and Sequential Postemergence Herbicide Applications by L.B. McCarty, J.M. Higgins, L.C. Miller and T. Whitwell.
- 2499--Comparison Using the Enzyme-Linked Immunosorbent Assay (ELISA) of Various Antigens and Their Ability to Detect Protective Antibodies Formed in Response to *Pasteurella Multocida* by A.P. Avakian, J.W. Dick, W.T. Derieux and C.W. Henry.
- 2500--Grouping Normal Distributions with Unknown Parameters by Peter M. Burrows.
- 2501--Contributions of the Title III Meals Program to Nutrient Intake of Participants by Kimberly B. Holahan and M. Elizabeth Kunkel.
- 2502--The Response of Asexual Spores (Conidia) of the *Camellia* Dieback Fungus, *Glomerella cingulata*, to Captan by Luther W. Baxter Jr. and Susan G. Fagan.
- 2503--Registration of 'PD 279' Tobacco by Currin, Pitner, Fortnum and Parrott.
- 2504--Multi-Colored Presentation Slides -- Easy and Inexpensive by Jeffery Higgins.

- 2505--Effect of Holding Time and Temperature of Bovine Whole Blood on Concentration of Progesterone, Estradiol-17B and Estrone in Plasma and Serum Samples by K.F. Breuel, J.C. Spitzer, T. Gimenez, D.M. Henricks and S.L. Gray.
- 2506--Vesicular-Arbuscular Mycorrhizal Fungal Spore Production as Influenced by Plant Species by J.E. Struble and H.D. Skipper.
- 2507--The Effects of Northern Fowl Mite Populations on Poultry: How Far Have We Come? by L.A. Lemke and J.B. Kissam.
- 2508--Evaluation of Urban Pest Management Programs by Patricia A. Zungoli, William H. Robinson and Michael J. Raupp.
- 2509--Gross And Histological Characterization of Endometrial Tissues from SLA Miniature Pigs with Cystic Endometrial Hyperplasia by K.J. Lipetz, M.E. Richardson, K.W. Ivey, J.F. Dickey, L.D. Stuart and J.R. Diehl.
- 2510--Evaluation of an Infrared Sensor as a Noncontact Thermometer by C.E. Thompson and J.R. Diehl.
- 2511--Hydrolysis of 4-Nitrophenyl Organophosphinates by Arylester Hydrolase from Rabbit Serum by J.R. Grothusen, P.K. Bryson, J.K. Zimmerman and T.M. Brown.
- 2512--Adult Feeding Behavior of Heliothis zea (Lepidoptera: Noctuidae), with Special Regard to Nectar Flow by Peter H. Adler.
- 2513--Partial Purification of Rabbit Serum Arylester Hydrolase by J. K. Zimmerman and T.M. Brown.
- 2514--Effects of Three Low Level Alternating Current Electrical Fields on Rate and Morphology of Development of Murine Embryos in Vitro by J.F. Dickey and J.L. Clarkson.
- 2515--A New Species of Photomorphus (Hymenoptera: Mutillidae) from Florida by Donald G. Manley and Mark A. Deyrup.
- 2516--A New Species of Dasymuthilla (Hymenoptera: Mutillidae) from Florida by D.G. Manley and M.A. Deyrup.
- 2517--Movement and Degradation of Aldicarb Residues in South Carolina Loamy Sand Soil by R.O. Hegg, W.H. Shelley, R.L. Jones and R.R. Romine.
- 2518--Modeling Ventilation Systems for a Stacked Cage Broiler Facility by W.H. Allen and O.T. Price.
- 2519--Spore Production by Two Vesicular-Arbuscular Mycorrhizal Fungi as Influenced by Container Size by Struble and Skipper.
- 2520--Camellia chrysantha Susceptible to Canker by Luther W. Baxter Jr., W.L. Ackerman and Susan G. Fagan.
- 2521--Macroelements in the Circulation of Coccidiosis-Infected Chicks by D.E. Turk.
- 2522--The Scientific Method -- Past and Present by C.F. Armstrong.
- 2523--Facile Isolation of Glutathione-S-Transferase(S) from Bovine Lymphocytes by S. Gangjee, A.B. Bovine and A. Carver.
- 2524--Calibration and Use of the Watermark Model 200 Soil Moisture Sensor by Stephen J. Thomson and C. Fletcher Armstrong.
- 2525--Biology of Microplitis rufiventris, an Imported Parasitoid of Several Important Soybean Lepidopterous Larvae by Gloria S. McCutcheon and Willye Harrison.
- 2526--Pink Bollworm Moth Dispersal in and Around Cotton, Sugar Beets and Alfalfa by Donald G. Manley.



- 2527--Pheromone Trap Monitoring of the European Corn Borer in South Carolina by J.A. DuRant, D.G. Manley and R.T. Carde.
- 2528--Protecting Color in Fresh and Processed Meats by James C. Acton and R.L. Dick.
- 2529--Suppression of the Plant Parasitic Nematode Criconemella xenoplax by the Nematophagous Fungus Hirsutella rhossiliensis by C.G. Eayre, B.A. Jaffee and E.I. Zehr.
- 2530--"Sumor," a Multi-Use Sweet Potato by P.D. Dukes, M.G. Hamilton, Alfred Jones and M.J. Schalk.
- 2531--The Effect of Indol and Imidazole Compounds on Bacterial Spore Germination by D.P. Kruse and L.S. Donnelly.
- 2532--Induction of Callus from Stem Tissue of Tea by Carl H. Frish and N.C. Camper.
- 2533--Early and Late Season Pink Bollworm Moth Dispersal by Donald G. Manley.
- 2534--A New Species of Cuban Polycentropus (Trichoptera: Polycentropodidae) by Steven W. Hamilton.
- 2535--Relative Resistance of 16 Southern Pea Cultivars to Root-Knot by Wesley Witcher and Wayne L. Ogle.
- 2536--Quality of Individually Shrink-Wrapped Tomatoes by G.J. Hulbert and S.R. Bhowmik.
- 2537--Progesterone Following hGC in Beef Heifers by K.F. Breuel, J.C. Spitzer and D.M. Henricks.
- 2538--Response of Soybean Cultivars to Bradyrhizobium Japonicum Strain 110 by Howle, Shipe and Skipper.
- 2539--Tolerance of Two High Quality Turfgrass Cultivars to Selective Postemergence Grass Herbicides by J.M. Higgins, L.B. Carty, T. Whitwell and L.C. Miller.
- 2540--Short-Range Pink Bollworm Moth Movements and Their Effect on a Mass-Trapping Program by Donald G. Manley.
- 2541--Improved Detection of Insecticide Resistance Through Conventional and Molecular Techniques by Thomas M. Brown and William G. Brogdon.
- 2542--Weaning Weights, Comingling, Pen Concentrations and Room Temperatures as Factors Affecting Young Pig Performance by J.C. McConnell, J.C. Earle and R.C. Waldorf.
- 2543--Herbicide Studies with Plant Tissue and Cell Cultures by N. Dwight Camper.
- 2544--Extraneous DC Voltage Levels on South Carolina Dairy Farms by M.J. Buschermohle, J.M. Bunn, R.A. Spray and T.Q. Suddith.
- 2545--Extraneous AC Voltage Levels on South Carolina Dairy Farms by M.J. Buschermohle, J.M. Bunn, R.A. Spray and T.Q. Suddith.
- 2546--Root Distribution of Non-Irrigated and Trickle-Irrigated Peach Trees by D.J. Rhodes, C.F. Armstrong and J.T. Ligon.
- 2547--Life History and Seasonal Distribution of Xylenorinus saxeseni (Ratzeburg) in South Carolina Peach Orchards (Coleoptera: Scolytidae) by Joe Kovach and Clyde Gorsuch.
- 2548--Life History and Seasonal Distribution of Zylosandrus crassiusculus (Motschulsky) in South Carolina Peach Orchards (Coleoptera: Scolytidae) by Joe Kovach and Clyde S. Gorsuch.
- 2549--Breed Structure of Senepol Cattle by A.R. Williams, C.E. Thompson, H.D. Hupp and L.W. Grimes.

- 2550--Response of Young Peach Trees to Ambrosiella sulphrea, a Symbiotic Fungus of Xyleborinus saxeseni by Joe Kovach and Clyde S. Gorsuch.
- 2551--Registration of CU-2 Tobacco Germplasm by Albert W. Johnson.
- 2552--Registration of CU-5 Tobacco Germplasm by Albert W. Johnson.
- 2553--Registration of CU-25 Tobacco Germplasm by Albert W. Johnson.
- 2554--Registration of CU-131 Tobacco Germplasm by Albert W. Johnson.
- 2555--Response of Peach Trees to Mechanical Injury Simulating Damage Caused by Ambrosia Beetles by Joe Kovach and Clyde S. Gorsuch.
- 2556--Detecting and Relating Daily Tall Fescue Leaf Growth and Development to Environmental Parameters by L.M. McCarty, J.R. Haun and L.C. Miller.
- 2557--Harborage Preference by Periplaneta Americana (L.) and Periplaneta Fuliginosa (Serville) (Dictyoptera: Blattidae) in a Home in Clemson, South Carolina, by Eric P. Benson.
- 2558--Observations on Lomamyia longicollis (Neuropetera: Berothidae) in South Carolina by Jeffrey A. Brushwein.
- 2559--Characterization of a Blackeye Cowpea Mosaic Virus Strain from South Carolina by J.F. Murphy, O.W. Barnett and W. Witcher.
- 2560--Evolution of Feeding and Case-Making Behavior in Trichoptera by John S. Weaker III and John C. Morse.
- 2561--Soaking Camellia Scions in a Benomyl-Captan Suspension Is Safe by Luther W. Baxter Jr., Susan G. Fagan and Sally B. Segers.
- 2562--Sparing Effects of Intrauterine Treatment with Prostaglandin E2 on Length of Luteal Function in Cycling Gilts by B.A. Akinlosotu, J.R. Diehl and T. Gimenez.
- 2563--First Service Pregnancy Rate in Beef Heifers as Influenced by Human Chorionic Gonadotropin Administration Pre-And (Or) Postbreeding by K.F. Breuel, J.C. Spitzer, C.E. Thompson and J.R. Breuel.
- 2564--Cylindrocladium Root Rot of Kiwifruit by J.P. Krausz and J.C. Caldwell.
- 2565--A New Method for Thermal Process Evaluation of Conduction Heated Foods in Retortable Pouches by Santi R. Bhowmik and Shweta Tandon.
- 2566--Water Quality, Zooplankton Production and Larval Striped Bass Growth and Survival Under Different Fertilization Regimes by Shari A. Lunardini, Arnold G. Eversole and Reginal M. Harrell.
- 2567--Relationships Among Australian and North American Isolates of the Bean Yellow Mosaic Potyvirus Subgroup by O.W. Barnett, J.W. Randles and P.M. Burrows.
- 2568--Thermal Tolerance of Early Life Stages of Northern and Florida Largemouth Bass: Exposures to Elevated Temperature by Kirsten G. Storms, Jeffrey W. Foltz and Edward W. Wilde.
- 2569--Timing of a Lighting Period for Easter Lily Bulbs Prior to Forcing by A.J. Pertuit Jr. and J.W. Kelley.
- 2570--Spawning Utilization of Abandoned Ricefields by Blueback Herring by D.V. Osteen, A.G. Eversole and R.W. Christie.
- 2571--New Observations on Camellia Leaf Gall by Luther W. Baxter Jr. and Susan G. Fagan.
- 2572--Bionomics of Lomamyia hamata (Neuroptera: Berothidae) by Jeffrey R. Brushwein.



- 2573--An Assessment of the Endocrine Impetus for Divergent Tissue Growth Patterns Among Sex Phenotypes in the Bovine by T. W. Gettys, D.M. Henricks and B.D. Schanbacher.
- 2574--Gametogenesis and Spawning in North American Clam Populations: Implications for Culture by Arnold G. Eversole.
- 2575--Report of a Tom Turkey Incubating and Hatching Eggs by G.P. Birrenkott, B.L. Hughes, M.E. Wiggins and W.H. Burkey.
- 2576--Ability of a Cimetidine to Increase Intestinal pH of Chicks by N.E. Ward, J.E. Jones and D.V. Maurice.
- 2577--Effects of Water Hardness Upon Lipid and Mineral Metabolism in Rabbits by Linda P. Porter, M.S. and Robert F. Borgman, D.V.M., Ph.D.
- 2578--Water Hardness, and Mineral and Lipid Balances in Rabbits by Robert F. Borgman and Stephen F. Lightsey.
- 2579--Potassium, Boron, Nitrogen and Life Effects on Corn Yield and Earleaf Nutrient Concentrations by J.R. Woodruff, F.W. Moore and H.L. Musen.
- 2580--Ca, Mg, Blood Pressure by Robert F. Borgman, D.V.M., Ph.D., and Stephen F. Lightsey, M.Ag.
- 2581--Growth of Geocoris punctipes (Hemiptera: Lygaeidae) on Attached and Detached Leaves of Pest-Resistant Soybeans by D.J. Rogers and M.J. Sullivan.
- 2582--Development of Paleorista laxa (Diptera: Tachinidae) in Heliothis zea (Lepidoptera: Noctuidae) Larvae Fed Pest-Resistant Soybean Genotypes by D.J. Rogers and M.J. Sullivan.
- 2583--Nearly Unbiased Estimation of Nonlinear Prevalence Functions by Peter M. Burrows.
- 2584--Heat Pump as a Latent-to-Sensible Heat Transfer Unit by Perng-Kwel Lei and J.M. Bunn.
- 2585--Reaction of Soybean Genotypes to Four Isolates of Peanut Root-Knot Nematode by Hiatt, Shipe and Lewis.
- 2586--A New Species of Ceraclea (Arthripsodina)(Insecta: Trichopirera: Lepoceridae) from Lake Tanganyika by John C. Morse.
- 2587--Application of a Three-Point Hitch Dynamometer by I.T.H. Garner, R.B. Dokdd, Dan Wolf and U.M. Peiper.
- 2588--Cutting Back Camellias by Luther W. Baxter, Peggy A. Mitchell and Susan G. Fagan.

COOPERATIVE EXTENSION SERVICE  
B.K. Webb, Director

As the educational outreach arm of the Clemson University College of Agricultural Sciences, the Cooperative Extension Service provides information and statewide continuing education programs that can make life easier and more enjoyable for every South Carolinian. The programs cover 16 disciplines relating to agriculture, home economics, youth and community development, special programs for limited-resource farmers and the economically disadvantaged in addition to general education information. They are made possible through an agreement between Clemson University and the USDA.

Funded by federal, state and county governments, the Extension

Service was created in 1914 as a nationwide system designed to carry education from land-grant universities to the people. For 71 years Extension has worked closely with South Carolinians helping them build a better life through dissemination of practical, useful information within its assigned areas of responsibility. Originally conceived to help rural people, Extension responded to the changing needs of those it served by broadening its scope of activities to include urban and suburban problems.

Clemson University, through Extension, maintains an office manned by county agent personnel in each county. A professional staff of Extension subject-matter specialists at the University and four Research and Education Centers around the state compiles information from research and translates it into data the people of South Carolina can use day-to-day.

From basic cooking demonstrations to irrigation field tours, Extension staff members are teachers carrying Clemson University educational programs to all areas of the state.

The Extension program is organized around these broad categories: agricultural programs, 4-H and youth development, home economics, community development, special programs for limited-resource farmers and 1890 programs conducted by South Carolina State College in cooperation with the Clemson University Extension Service.

#### Agriculture and Natural Resources

Agriculture and natural resources Extension programs deal with the needs, interests and problems of South Carolina citizens. These programs address the management, protection and utilization of water, wildlife, forest land, ornamental plants, public health, and community and recreational resources, as well as the production of food and fiber. Highlights of Extension programs in this area for 1985-86 follow:

##### Agricultural Economics -- Farm Management and Marketing

The function of Extension Agricultural Economics is to provide educational information and training to farmers, Extension agents, agri-business and consumers about agricultural marketing, farm and financial management, agricultural policy and international trade. Workshops, county meetings, publications and audio-visual support were the main teaching and training activities.

The major thrust this year centered on the farm financial crisis and implementing management and marketing programs to help farmers deal with financial stress. An in-depth survey confirmed the severity of farm financial problems in South Carolina. A \$58,500 grant was received from the Extension Service-USDA to help fund the Clemson University Management Assistance Program (CUFAN). This program was targeted specifically to farmers who were experiencing serious financial problems and needed assistance in evaluating their financial situation and alternatives. Highlights of the farm management and marketing program included:



- o Conducted in-service training on financial management for 100 agricultural and home economics agents.

- o Established a Quick Response Team of 14 agricultural agents to work with farmers in financial crisis. These agents received an additional 14 days of in-service training in computer applications and financial management.

- o Established a toll-free hotline into the Department of Agricultural Economics and Rural Sociology for farmers to call to request farm management assistance.

- o Took the lead in organizing and conducting an agribusiness alternatives conference for farmers in South Carolina. The conference drew 200 participants.

- o Held 25 marketing workshops and county meetings.

- o Held 28 farm and financial management workshops and county meetings. Conducted a statewide agricultural policy and outlook conference for 175 participants. Conducted a week-long agricultural lenders school for 20 lenders.

- o Conducted two statewide agricultural trade policy meetings.

- o Prepared an industry-wide weekly peach report with support from the Agricultural Marketing Service and the National Peach Council. Continued emphasis on fruits and vegetables as alternative crops by holding 25 county producer meetings.

- o Developed forage budgets and expanded the farm management marketing program with beef cattle and swine.

- o Assisted the poultry department in meetings with industry groups and producers. With funding from the Chicago Board of Trade, 15 Extension agents received training in hedging and agricultural commodity options.

- o Participated with SCS in conducting in-service training on Conservation Tillage for SCS and ASCS staff.

- o Developed computer analyses for participation in the provisions of the 1986 farm bill and dairy buy-out program. Worked with producers, other agencies and organizations on explaining the conservation reserve program and the 1986 wheat referendum.

- o Worked closely with commodity and farm organizations such as Farm Bureau, S.C. Soybean Board, S.C. Beef Cattle Association and other agencies and organizations.

Literature development received major educational emphasis. Current economic topics and issues influencing farming were updated in "Outlook Update" and "Management-Marketing Memo" newsletters. Publications included "Extension Economics Reports," leaflets and circulars, and a new publication on the financial problems in South Carolina's agriculture. Budgets and major crop and livestock enterprises were prepared and used extensively. Weekly marketing reports were prepared for peaches, cotton and general marketing information. Computer programs were written for a wide variety of commodity and management applications.

#### Agricultural Engineering

Livestock waste lagoons, which serve a large segment of South Carolina's swine, poultry and dairy industries, are the subject of

better design, construction and operating procedures. This total effort, cooperatively conducted by the Clemson Extension Service, the USDA-Soil Conservation Service, and the S.C. Department of Health and Environmental Control, is resulting in greater benefits to the livestock producer and the natural resources of the state.

Improved wiring practices in accordance with the National Electrical Code are a likely solution to the problem of stray voltage on dairy and swine farms. In addition, adequate electrical grounds are proving beneficial to farmers and homeowners alike in reducing problems associated with lightning. Wiring, particularly grounding, are areas of increased educational effort.

Computer training is very popular and productive for 4-H'ers in the state. More than 275 4-H'ers using 22 computers received hands-on instruction at the 4-H Electric Project Amp Camp.

A 1985 survey of on-farm pesticide application found significant errors in pesticide application rate among the 121 operations checked. Results of this study are being used in the development of new training programs and educational materials.

In-depth training of Clemson Extension staff in residential moisture control has increased our ability to handle the many problems on this topic. Moisture control, along with remodeling and reconditioning of existing homes, receive major inputs of resources.

Two volumes of revised and updated house plans have been prepared for distribution. These and plans for community buildings such as rural fire stations are subjects of many requests. A farm accident rescue program for training emergency medical and fire rescue personnel was initiated and will be used to train rescue personnel in the unique aspects of agricultural accidents and extrication.

"Get Fired Up," an in-school 4-H fire safety program, was expanded to reach 10,000 fifth graders and an estimated 38,000 family members in 22 of the state's counties. Continuing expansion of this program in the coming year has been made possible by additional financial support from the state legislature and insurance companies.

Several demonstrations of small farm irrigation technology have expanded program needs in this area. Adaption of computer software to these problems has enhanced our capacity to deliver the needed information.

On large farms conservation of irrigation water is a high priority. Furrow diking is a compatible practice. Interest in chemigation and fertigation has emphasized the need for educational programs on protecting water supplies from contamination.

Timely weather information is made available to the South Carolina agricultural community by the Agricultural Weather Office. Twice daily, at 5:30 and 10:30 a.m., advisories are prepared for broadcast media. Bimonthly 30-day forecasts are prepared for both the broadcast and print media.

Weather data from observation sites throughout the state and in bordering counties are stored in data bases for use in several commodity management models. Climatological summaries are prepared weekly from these data for dissemination to users of the Weekly Weather and Crop Report. Special summaries also are prepared for other Extension specialists who use timely weather information in



their educational programs. Most of the weather information available over the National Weather Service weather wire is now available to users of the CUFAN network and other Clemson computer systems.

### Agronomy and Soils

Agronomic crops account for over half of the state's agricultural income. The transfer of educational information relating to these production systems is a partnership between county staff and Extension specialists located at the Clemson campus and the Pee Dee and Edisto Research and Education Centers. The work is planned and implemented by Extension program management teams. Specialists from several departments and county staff are members of these teams. Thus, input from county advisory committees can be integrated with research findings from Clemson and surrounding states resulting in a balanced program which provides cost-effective options to producers. The primary programs are:

- o Tobacco. The program continues to emphasize judicious use of high analysis fertilizers and management practices which result in high quality leaf at a minimum cost.

- o Soybeans. BEAN-AID, an expert system, has been further developed to supply pest control and problem diagnostic information in addition to variety selection information.

- o Corn. The Clemson edition of the National Corn Handbook has been made available to producers and businesses in the state. The corn program has been developing a data base for evaluating the effectiveness of our technology transfer process. Other program thrusts include efficient use and placement of fertilizer, tissue and soil analysis, and population management.

- o Cotton. Development of a computer model of the growth process for the cotton plant is being evaluated on farms for its potential in managing fertilization, irrigation and other production practices. COTTONTEX, a video-tex computer program, is being developed to present cotton production recommendations in a rapidly accessible manner. Production recommendations continue to emphasize high yields and quality fiber.

- o Forage livestock systems. Several accomplishments include remedial action information for fungus-infected fescue pastures which was incorporated into field days and grower meetings, a short course in pasture management, and development of a simulation computer program to help in pasture management. The potential of alfalfa hay as a cash crop is being promoted to producers, particularly those who have been growing row crops on land unsuitable for cultivation.

- o Small grains. This program has focused on showing how small grains can be used with major row crops to form a more cost-effective cropping system.

- o Soil management and conservation. Soil testing, fertilizer placement and timing, conservation tillage, and other soils-related information continue to support the various crop management programs by demonstrating how soil resources need to be properly managed to achieve optimum balance between production costs and economic returns.

o Weed control. Since weeds account for major yield losses, cost-effective weed control is important in each of the crop management programs and is an integral part of those programs. In addition, an identification project for major troublesome weeds has been conducted annually to help county agents and agribusiness representatives do a more effective job in advising farmers about the most economical approach to managing their weed problems.

Major emphasis is being placed on development of expert systems to help producers diagnose problems and optimize their management of cropping systems.

#### Animal Science

The boar and bull test stations at Clemson, Edisto and Pontiac continue to play significant genetic, educational and public relations roles. Producer satisfaction keeps prospective buyers coming back year after year. Genetically superior males have shown the ability to sire faster-growing, quality offspring that consume less feed per pound of gain.

Last fall, the performance of the tested boars was 2.22 pounds of gain per day with an overall feed conversion of 2.28. This performance level was greater than in any previous group. One pen of Yorkshire boars had a feed conversion of 1.98 pounds, and the top selling boar from the pen went to Swine Genetics International of Cambridge, Iowa.

Bull performance at Clemson and Edisto is still climbing. The average daily gain was 3.27 and 2.73 respectively. The 365-day weights at Clemson averaged 1,150 pounds, and 1,320 pounds at 452 days at Edisto. The highest selling bull at Edisto, a Charolais at \$6,600, went to Montana. Both stations have sold bulls out of state. The states include North Carolina, Georgia, Missouri, Iowa, Tennessee, Virginia, Wisconsin and Alabama. There appears to be a trend to sell some of the gain leaders to more distant buyers. We hope this is due to the reputation of the South Carolina test program and respect for efforts to improve both swine and beef genetics.

A number of these sires are sold by telephone and video. The challenge is how to sell in the future. Do we sell through auctions and telephone conferences, or do we concentrate on a couple of locations in the state with both conference and video hookups?

#### Aquaculture, Fisheries and Wildlife

The 4-H catfish cage culture project has been expanded to 42 units in 21 counties. The fingerlings, cage materials, feed and literature are supplied to the 4-H'ers by Clemson University. This program covers feeding, marketing and product acceptability of home-grown channel catfish.

A modular diagnostic fish disease laboratory is in place and is presently being equipped. The lab will service producers and researchers with fish disease problems in South Carolina. In addition to the lab at Clemson, a satellite lab is being established at the S.C. Wildlife and Marine Resources Department (SCWMRD) facility at



Fort Johnson. Both labs will operate under the auspices of the S.C. Aquaculture, Fisheries and Wildlife Cooperative supported by Clemson University and SCWMRD.

Funding has been appropriated for an aquaculture demonstration center to be located in Hampton County. The facility will be used to demonstrate state-of-the-art fish culture, pond construction and aquaculture mechanization.

A new program, integrated forest and wildlife management, was initiated to address the needs of private and industrial forest landowners who are using commercial hunting recreation as a major additional income source from commercial forests. This program is a cooperative program under the AFW Cooperative. The rapid expansion of lease hunting is a regional phenomenon produced by the severe economic climate of the past five years. An Extension publication, "Income Potential from Wildlife," is one of a series of publications stressing alternative income sources for S.C. farm and forest landowners.

Seven presentations have been conducted for farm and forest landowner groups around South Carolina on such topics as integrated forest and wildlife, income potential from wildlife and considerations in leasing hunting rights. Work has been initiated on development of a permanent forest-wildlife management demonstration area. The area is an 800-acre tract in Pickens County. Development work is being done in cooperation with the Clemson University Forestry Department and SCWMRD.

In addition, these phases of projects are under way:

- o Publications on integrated farm, forest and wildlife management, model hunt leases, and further work on the characteristics of South Carolina hunt lessees and lessors.
- o Development of a waterfowl habitat management demonstration area in cooperation with SCWMRD.
- o Cooperation with SCWMRD on developing a method to determine local fair market hunt lease values.
- o Preliminary agreements with several landowner associations to conduct in-field demonstrations on how to improve wildlife habitat on lands managed primarily for forest products.

#### Community Development

The Extension Community Development program helps rural communities improve the quality of life by providing educational and technical assistance to solve community problems. Emphasis is placed on helping community leaders, elected and appointed local officials, community-based organizations and professional staff of other agencies solve community problems by using available resources to maximum advantage.

Community development projects include helping local governments identify and prioritize needed community services, training local leaders to participate more effectively in community problem-solving processes, and helping communities locate sources of financial and technical assistance to accomplish projects.

Rural towns are assisted in conducting leadership and problem

identification surveys; community lay leaders and officials are provided timely information about available government assistance programs; and community problem-solving capacities are increased through Extension's co-sponsored training programs.

The results of Extension's involvement in community development efforts include improved recreation facilities, successful recruitment of new businesses, enhanced appearances of downtown areas and increased cooperation between elected officials and local leaders. Programs are conducted on crime prevention, community revitalization, agricultural land protection and local government operations. Community leaders are also assisted in identifying and analyzing impacts of new trends on community concerns such as tourism, water quality and land use.

Extension cooperates with the Governor's Office in conducting two major programs designed to improve rural communities. One is the annual Emphasis/South Carolina program through which outstanding community improvement efforts by individuals and organizations are recognized. More than 300 people representing 37 counties participated in this year's program. The other statewide program is the Governor's Rural Development Leaders School, a four-day school held annually since 1983. To date, more than 400 rural leaders have taken part in this school.

Other areas of community development programming include educational and technical assistance to rural residents in cooperation with the Soil Conservation Service through the Resource Conservation and Development program; training for volunteer fire department personnel and elected officials on the impact of fire protection on insurance premiums and organizational procedures for establishing rural fire districts; training for small town managers and staffs in using microcomputers for word processing, accounting and data management; and assistance to small towns in efforts to generate more revenue through downtown revitalization projects. Results of recent Extension problem identification surveys conducted in cooperation with Extension support groups and advisory committees across the state indicate community development will continue to be a priority for Extension.

#### Dairy Science

An integrated reproductive management program was continued on 22 dairy farms in the state. Average calving interval decreased 0.2 months and milk production increased nearly 1,000 pounds per herd since the initiation of the program two years ago. In the area of milking management, individual farm visits were conducted. Educational programs were conducted on proper milking procedures and the prevention of mastitis. Several milking systems were analyzed to determine proper function. Educational programs were conducted with producers on ways to improve milk quality by reducing somatic cell count of milk. Programs were presented on prevention of antibiotic residues in milk and meat. This is funded by the Residue Avoidance Project (RAP).

Nearly 30,000 dairy cattle in South Carolina are enrolled in the Dairy Herd Improvement Program (SCDHIA). In coordination with SCDHIA,



the 11 DHI associations and the SCDHIA supervisors, Clemson dairy scientists give leadership and guidance to the educational activities of the vast record-keeping and management systems. Twenty of these herds are enrolled in the Direct Access to Records by Telephone program. Latest dairy herd management information is available through this computer program for participation with dairy producers. Milk production in South Carolina in 1985 averaged 14,435 pounds per cow per year. This is up 10 percent from the production level in 1984 and up 78 percent from 1970. The value of milk produced per cow was \$2,151 per year. Feed cost per hundredweight of milk was \$5.92 in 1985, down from \$6.82 in 1984. This lowered feed cost was extremely important in helping keep many of the state's dairy producers in business.

A new least-cost computer feeding program was obtained and implemented during the year. More than 500 least-cost dairy rations were formulated by Extension dairy specialists and area Extension agents. In addition, more than 1,500 feed and forage samples were submitted for chemical analysis. Dairy science nutrition programs are being developed for CUFAN (Clemson University Forestry and Agriculture Network).

Extension dairy scientists worked with dairy organizations on marketing, merchandising and promoting milk and other dairy foods. Further educational programs in milk and dairy product utilization are being implemented.

## Entomology

The red imported fire ant continues to trouble South Carolinians, and Extension receives many calls about control. Fire ants can be controlled with slow-acting bait products, but the public fails to understand that patience is required for them to work. Extension entomology considers education of the public about fire ant bait products (PRO-DRONE, AMDRO, LOGIC, etc.) a top priority. Demonstrations in Colleton, McCormick, Calhoun, Jasper and Oconee counties are ongoing to demonstrate better control over time with fire ant baits.

Mole crickets continue to cause severe damage to lawns and recreational turf areas in the Coastal Plains areas of South Carolina. Not only is damage unsightly, but it reduces the playability of golf courses and impacts the tourist industry. Most of the damage is caused by two imported species, the Southern and the Tawny mole crickets. Both are found as far north as the Grand Strand area.

Adult mole crickets are strong fliers who are attracted to fine turf areas. This makes control difficult, since reinfestation is a constant threat. Mole crickets appear to be developing resistance or tolerance to many of the insecticides currently labeled for control. Another factor that causes control problems is high water pH. Most insecticides break down rapidly in water with a pH higher than 7.8. Water may reach a pH of 9.0 during the summer months.

Extension entomology has conducted demonstrations in Horry and Charleston counties to show proper management strategies and to evaluate new materials for cricket control. Control of fire ants and mole cricket management will be high priority programs for Extension entomology during fiscal 1986-87.

## Food Science

Extension food science program activities included 69 on-site food processor plant advisories dealing with processing techniques, equipment, packaging and sanitation quality assurance problems. Another 192 informational responses (other than on-site) to food processors, Extension personnel, citizens and state agencies (both in and outside South Carolina) were handled. This represented an estimated value of \$2.3 million to clientele in improved processing efficiency and product quality, reduced spoilage and less food-borne illness.

Examples of project accomplishments include equipment heat distribution and live crab penetration demonstrations enabling a new crab meat processing facility to start operations. Subsequent pasteurization vat equipment design advisories and development of crab meat pasteurization processing schedules provided an expansion of the company's product line into the six-month shelf life pasteurized crab meat market. Start up of this South Carolina facility represented a new venture capital investment of about \$1 million.

Other demonstrations established safe commercial canning process schedules for imported oyster meat and meat hash, and the procedures necessary for canning commercially raised trout. More than 30 new venture advisories were provided to assist clientele in the development of facility layouts, processing/preserving procedures, packaging options and/or compliance with state and federal regulations to commercially process seafood and baked bean seasoning mixes (dry), seafood sauces, honey coated pecans, fresh sausage, frozen dressed catfish, sugar-free jam and jellies, dietetic cookies, packaged goat cheese, sweet potato chips and patties, clarified apple cider, dehydrated vegetables/fruits and frozen sulfite-free peaches. In addition, on-site processing advisories were provided at 10 community canneries sponsored by high schools and low-income agencies.

Another technology transfer activity, in cooperation with College of Agricultural Sciences researchers, on adapting a continuous hyperfiltration technique to simultaneously press, clarify and cold pasteurize fruit juices resulted in a processing patent application, which will be assigned to Clemson University when granted.

More than 67 notices (averaging 95.5 contacts per notice) of proposals, changes and new federal and state regulations were distributed to 1,050 South Carolina food industry companies by the Extension Food Science Food Regulation Information Filter Center. This enabled processors to participate in the promulgation of responsible regulations and avoid possible citations, fines or adverse publicity by having lead time to implement necessary regulatory compliance changes. Educational public service information on labeling waxed fruit, sulfites, home preparation of sauerkraut, hyperfiltration and preservation of commercial foods by irradiation were developed for the news media and incorporated into five newspapers, two trade journals and an Extension publication reaching an estimated 750,000 South Carolinians.

Other program activities included providing leadership in several food processing, trade and professional associations, and serving as the Institute of Food Technologist regional communications represen-



tative for South Carolina. Late in the 1985-86 year, a second Extension food scientist was added to the food science faculty.

### Forestry

Reforestation of cutover nonindustrial private lands continues to be a major problem in South Carolina. A new effort in solving this problem centers on the demonstration of herbicides for site preparation, pine release and weed control. Herbicides are often more cost effective and do less damage to the site and the environment than more conventional processes such as mechanical site preparation. New chemicals and new treatment techniques are being demonstrated in 18 counties. These demonstration areas are increasing landowners' use of chemicals for managing their forest lands.

Extension forestry has a new publication aimed at helping landowners manage mixed stands of hardwoods and pines. In the past we have concentrated on either pine management or hardwood management. In natural conditions, which includes more than 80 percent of our forest lands, pines and hardwoods form a mixture of trees. These stands need to be managed differently. "Forestry Acre by Acres" compiles the best knowledge available on mixed stand management. The publication is being used throughout the South.

Clemson Extension hosted the National Extension Forestry Workshop this year in Charleston. The meeting was the largest and most productive ever held by this group. Extension foresters from 38 states evaluated their programs and began planning for the 21st century. Techniques such as business and market planning and futuring were used to provide direction. States planned to share their educational resources with their neighbors.

Developing local leadership and providing educational forestry programs continue to be emphasis areas for Extension forestry. The formation of county landowner associations continues to be one of our major efforts. We now have 14 county forest landowner associations. These groups are meeting several times each year to learn more about managing their resources. In addition, they are providing leadership by starting their own activities such as library packets for local schools, volunteer visits to neighbors with forestry problems, multi-county tours of forestry practices and meeting with local resource groups and legislative leaders. Counties with forest landowner associations are making real progress in addressing their forestry problems.

### Horticulture

In South Carolina horticulture involves more people than any other phase of agriculture. More than 2 million South Carolinians are actively involved with production or maintenance of horticultural crops. The annual production and maintenance value of horticultural crops is more than \$500 million. Furthermore, this maintenance effort is directed toward protection of a plant materials investment of more than \$2 billion.

The majority of questions directed to the Clemson University

Extension Service are related to home grounds and gardens. A team approach of county personnel, area agents and state specialists is used to provide homeowner information. Television programs have been developed and are distributed on a regular basis to 11 commercial stations (one of these stations has 80,000 viewers) and more than 200 cable stations in seven southern states. A 30-minute pilot was prepared at the request of ETV. TV inserts used regularly on television station WYFF in Greenville also give Clemson home horticulture nationwide coverage on CBN network. Radio programs are distributed to 75 stations in four states. In addition, Master Gardener volunteers assist by distributing basic horticulture information to thousands of clients.

Demonstrations for commercial producers were used extensively in 1985-86 to demonstrate new techniques to growers and field staff. In-service training by Extension specialists is another education method used to update field staff in the area of small fruits, nursery production, turf and vegetables. Static and non-static exhibits were prepared for garden shows, plant problem clinics, fairs and other special interest areas. Clemson also hosted regional and state short courses in the area of peaches, nursery crops, floriculture and turf during this reporting period.

#### Plant Pathology and Physiology

Plant Pathology and physiology education programs emphasized nonchemical control of nematodes in field crops this year. The objective was to provide ways of systematically controlling certain plant parasitic nematodes over several years for those growers with resources to plan a few years ahead. This means that at times the nematode control costs must be borne this year for next year's production.

The basic premises were that if nematodes were not a problem, they could be prevented from developing to menacing populations by using alternate crops. Likewise, if certain nematodes have become a problem, then the populations can be reduced by using either certain resistant varieties or nonhosts. Such a program is complicated and depends on providing the means of getting nematode species identification, providing threshold guidelines that can be used to translate numbers of nematodes recovered from the soil into predictable economic losses, and having the agronomic varieties that will produce a reasonable yield. Each farm represents a unique system that must be planned for separately. Ongoing research will help define the kinds of problems that can be treated in a given situation.

A program was implemented to develop an interactive electronic communication system for the Plant Problem Clinic and other activities in the unit. Replies can be returned to counties as diagnoses are made, and timely information is electronically dispersed to pertinent locations. Preliminary work has been done for developing aids for diagnosis and plant disease information files. Individuals in the unit received training in various computer uses and operations. It is anticipated that services will be increased in quality and quantity as facilities and knowledge are increased. In addition, the 1985 Plant Pathology and Physiology Extension program continued with integrated



pest management programs, field demonstrations, educational efforts and service activities. The Plant Problem Clinic made 2,300 diagnoses involving every South Carolina county.

### Poultry Science

Poultry and egg supplies continued to increase to meet the demands; however, abundant supplies and lower grain prices contributed to lower broiler and egg prices than in 1984. Preliminary South Carolina farm market values for poultry in 1985 were down about \$207 million from 1984 to about \$186 million. Turkey values increased about 32 percent. Turkey numbers increased by more than 30 percent to meet an increasing need for further processed turkey products. South Carolina is the second fastest growing state in turkey production. Broiler production in pounds has increased about 10 percent per year for the last several years. South Carolina is the fastest growing state in broiler production -- the state will see a 12-15 percent increase in layer numbers in 1986. Many new hen houses with capacity of 100,000 birds are being constructed. A few of these will replace smaller, older facilities.

Extension works closely with poultry producers. Information meetings were conducted with county personnel from large poultry counties to update them on the industry and how to interact with it. There is still a large demand for cash flow projections as farmers contemplate building poultry production facilities. Industry-wide and individual meetings covering all segments of production and individual meetings have served the industry educationally and have improved public relations with the leaders. 4-H poultry teams and individuals continue to represent South Carolina well, bringing the 1985 national 4-H barbecue championship back to the state. Poultry and egg embryology projects continue to be among the most popular 4-H programs.

### Sea Grant Marine Extension Program

The Clemson/Sea Grant Marine Extension Program (MEP) is an outreach effort of the South Carolina Sea Grant Consortium and the Cooperative Extension Service at Clemson University. Through a staff of three specialists in Beaufort, Charleston and Georgetown, it addresses constituent needs in four major program areas: living marine resources, coastal industries, coastal processes and marine education. In order to multiply its efforts, the MEP interacts with many local, state and national agencies such as the National Weather Service, the National Marine Fisheries Service, the National Marine Manufacturers Association and the other Sea Grant programs in all coastal and Great Lake states.

The golden crab research initiated by the MEP and SCWMRD in 1985 has led to a full research proposal funded by the Gulf and South Atlantic Fisheries Development Foundation. The fisheries specialists at the Marine Resources Department in conjunction with MEP are determining the golden crab habitats, how many there are, and how rapidly they reproduce. Golden crab is a large deep-water crab that has only recently been considered as a potential new species for commercial

fishermen to use as other species are being overfished.

The MEP is now a part of a cooperative agreement between Clemson University and SCWMD. Through this agreement various activities such as penaeid shrimp demonstrations and marine data base development are coordinated between the agencies involved.

In fall 1985 the MEP aquaculture specialist held a demonstration of penaeid shrimp farming techniques that had been researched in a Sea Grant project on coastal impoundments. Not only were there 50 land-owners present, but the program also attracted 30 Clemson Extension agents from nearby counties, 17 university students and various national and local media representatives.

In the 1980s it has become clear that local community leaders will have to be aware of more issues and technology than they have in the past. This is especially true in the coastal region of South Carolina where population dynamics are straining resources to their limits. To answer the need for better informed leaders, the MEP instituted "Leadership Beaufort" for 25 volunteer future community leaders. Topics such as history, economics, planning and development, and the environment were explained to the leaders who then discussed how these issues affect the coast where they live.

Intermodal transportation is revolutionizing the cargo business in the port of Charleston. Working with the industry and the College of Charleston, the MEP developed a curriculum aimed at college-level students and working industry staff. Through these courses people in industry can become better educated on systems involved with transferring containers from ship to train or truck. At this time these courses are difficult to find anywhere.

From April 1984 to January 1985 the MEP/PRT docent program allowed more than 4,000 park visitors to have interpretive tours on beaches and coastal parks from volunteer guides trained by MEP coordinated workshops. Before this program, park staff were unable to handle the growing need for information from a curious public due to limited budgets and staff.

### Special Programs

Extension's special programs area assists small farm families with low income and limited resources by providing educational information designed to improve their living standards. Extension personnel are used to identify problems and establish objectives in crop and livestock production, marketing, nutrition, housing, youth development and family life.

### Small Farms Program

The small farm is defined as a farm operated by a family that provides most of the labor and management, depends on that operation for a significant part of their income and has total income below the median non-metropolitan family income for the state. Videotapes, computers and other forms of mass media communications are being used to reach large audiences. Extension uses on-farm demonstrations, tours and field trips to reach the small scale farmer.



Deer have become a major problem for many gardeners and small truck crop growers in McCormick County. Integrated pest management demonstrations were used to introduce cost-effective alternatives for deer control to growers. Demonstrations on the control of parasites in livestock also were carried out for small farmers under the IPM program.

## Marketing

Selling the farm product is still a problem for the small farmer. The direct-to-consumer markets (farmers markets) continue to help more than 1,000 small farmers annually sell horticultural crops with cash sales in excess of \$2 million.

## Extension Home Economics

### Scope of Activity

Home economics is the only discipline that considers physical, technological, social and psychological factors within the context of the family. Extension home economics is committed to helping more than three million South Carolinians understand that the future of our state, nation and world is dependent on strong families.

Extension home economics programs center on five major areas: family economic stability and security, energy and environment, food and health, family strengths and social environment and leadership development. Extension home economics seeks to increase awareness of the needs of families in legislative deliberations and public policy. Helping people stay in control of their own lives and manage adequately in an increasingly high technological world is a challenge for Extension educators.

### Clothing and Textiles

Economic pressures have forced many individuals and families to look for alternative ways to clothe themselves for less. Reports from 72 percent of the counties indicate 133 construction and restyling classes helped 1,091 people reduce their clothing budgets. The savings were estimated at \$60,000. More than 700 persons have saved an estimated \$29,000 as a result of their participation in a series of color and wardrobe selection classes held statewide.

An additional savings of \$22,000 was estimated by agents as a result of questions answered about stain removal. A total of 5,216 persons took part in 201 other non-construction classes. The estimated savings was \$26,000, not counting the dollars saved when these new skills were put into practice.

Volunteers were used in a number of counties to extend Extension resources. In the clothing area, 125 volunteers worked with 2,116 individuals, donating 1,544 hours. At \$4.50 per hour, this time would have cost Extension \$7,000.

## Expanded Food and Nutrition Education Program (EFNEP)

EFNEP reaches limited-resource families, especially those with young children, and emphasizes the acquisition of skills, attitudes and changed behavior necessary for better nutrition and health. The program operated in 41 South Carolina counties during 1985-86 reaching 5,408 homemakers in the adult program and 7,720 youth in the 4-H EFNEP program. A total of 972 volunteers participated in EFNEP in 1985, contributing 20,920 hours valued at \$167,000.

Through basic lessons and picture recipes prepared by the state nutrition staff and taught by paraprofessionals, 73 percent of the homemakers in the EFNEP program have improved their dietary practices by eating more servings of food from the basic food groups. Eighty percent are producing and preserving some of their food at home. Ten percent are enrolled in or participating in Extension homemaker clubs or special interest programs.

Many persons enrolled in EFNEP receive either food stamps or food through the Women, Infants and Children (WIC) program. During the past year all the families in these programs received instruction on how to wisely use food stamps or WIC foods. Agreements were made between EFNEP and local food stamp and WIC offices for persons needing more education in food buying and meal planning to be referred to EFNEP.

## Family Life and Human Development

Goals of this program are to improve the quality of life of South Carolinians through programs to reduce the high infant mortality rate, to improve low scores on standardized tests and to reduce stress among families, particularly farm and textile families. Stress programs have been emphasized in Extension planning in the counties. Counties report that 75 stress-related programs were conducted this year and were attended by more than 3,000 persons.

The department, in conjunction with the State Department of Agriculture, produced a mass media information packet on "Coping With Change." The packet received excellent coverage in weekly and daily newspapers and response was very favorable.

To strengthen parenting skills, 2,000 parents of infant children received the Baby Talk series of informational leaflets. In an evaluation of 219 parents:

- o 70 percent said the information was very useful
- o 75 percent said they talked to their baby more
- o 67 percent said they smiled at their baby more
- o 73 percent said they played with their baby more
- o 55 percent said they responded to their baby more
- o 63 percent said they provided more things for their baby to feel, look at, listen to, smell and taste.

Participants said they felt more self confident and worried less about their babies as a result of the Baby Talk series.



## Family Resource Management

To aid in the family educational process and the current farm financial crisis, Extension agents were provided intensive in-service training this year in financial management and resource utilization. Extension home economics specialists at Clemson, working with Clemson's agricultural economists, the home economics department at Winthrop College and state and local service agencies, cooperated in providing this training.

During the year 25 counties reported delivering programs designed to improve use of resources. Throughout the state buying power has been increased by \$800,000 as a result.

## Food and Nutrition

With surveys showing South Carolina has the lowest life expectancy rate in the nation, the Clemson University Extension Service, the American Red Cross and the South Carolina Department of Education joined forces to market a new concept in nutrition education. One result was a 12-hour nutrition course entitled "Better Eating for Better Health." At a three-day workshop, instructors were trained for the course. During the year they, in turn, trained 84 Extension home economists, school food service supervisors and Red Cross staff members. As of September 1985, 450 persons in 35 counties had completed the course.

Clemson Extension has developed a comprehensive weight control program called DIET PUZZLE. Preliminary results from four participating counties indicate that about 75 percent of those signing up attended nine or more lessons. Better than 80 percent improved their scores on the post-test.

## Food Preservation

More than 60 percent of all South Carolina households preserve food at home, according to the findings of a statewide survey, and more than 25 percent use unreliable processes. The value of home-preserved produce exceeds \$78 million in the state. In light of these facts, Extension conducts a food preservation program in each county, and every major state health and education agency in the state refers questions on home food preservation to Extension. County evaluations show the following impact:

- o About half of workshop participants reported changing to recommended food preservation practices.
- o More than 1,000 fair participants were informed of product deficiencies in a revised statewide fair education program.
- o From May to September 1985, county offices answered more than 20,000 questions on food preservation and food safety.

## Housing and Interior Design

Special funding last year led to the training of 92 Extension

agents on wood decay problems in homes. Significant impacts have already been achieved in 10 counties and more than 10 additional programs were planned for 1985-86. Five counties had programs and tours of alternative housing such as modular or manufactured homes with more than 135 persons attending. Agents in 10 counties helped plan 140 new or remodeled rooms or storage areas. One county reported 125 Extension Homemaker club members installed smoke detectors in their homes and helped 15 homeowners select and install wood stoves.

County Extension personnel conducted special meetings on housing for 1,100 person, while other housing programs reached 1,160 persons. Exhibits, posters and displays reached 2,000 persons in nine months. Media coverage included 22 newspaper articles, 38 radio spots and four television shows. Fifty leaders were trained to provide information on energy-saving windows.

#### Volunteer Leadership Development

South Carolina's population increased 20.4 percent during the 1970s to 3,119,208 with projections for 1986 indicating a much higher figure. Reductions in Extension's appropriations and staff have emphasized the need for volunteer leadership development to meet the needs of this larger audience. The South Carolina Extension Homemakers Council has active councils in all 46 counties with 407 clubs and 6,568 members. A spring Savannah Valley District Citizenship Awareness tour and luncheon at Columbia attracted 260 Extension Homemakers and 20 legislators.

A team of three Extension agents and six Extension Homemaker volunteers attended a NEHC Southern regional workshop on family community leadership. This team is to train about 1,000 leaders in the coming year. The cost benefit of this program to the state will be more than \$100,000 since the volunteer time is donated and the expenses are paid by the South Carolina Extension Homemakers Council.

#### 4-H and Youth Development

The mission of the 4-H and Youth Development Program is to help youth ages 9-19 in South Carolina become self-directed, productive individuals who can make a positive contribution to our state and nation.

The learn-by-doing approach enables a participant to become actively involved in the learning process. These experiences assist the 4-H'er in day-to-day living and also provide an opportunity to explore careers.

#### Participation

The most successful 4-H programs are accomplished through organized community 4-H groups taught by adult/teen volunteers. In South Carolina, 3,549 adult volunteer and teen leaders gave leadership to 4-H programs in 1985. There were 15,721 youth enrolled in 960 4-H units and 29,558 youth enrolled in special-interest programs including



school enrichment programs, individual study or instructional TV. Also, 7,376 youth participated in 4-H camping programs conducted at the two state-owned 4-H camps, Camp Bob Cooper and Camp Long. Enrollment in the 4-H Expanded Food and Nutrition Education Program totaled 7,808. Seventy percent of the 4-H'ers live in rural areas and 30 percent in areas of 10,000 or more population. These 4-H curriculum areas have more than 5,000 participants:

individual/family resources	29,079
health/safety	10,505
animals/poultry	10,031
mechanical science	9,582
natural resources	9,166
plant sciences/crops	5,335

#### Program Emphasis

The primary emphasis for 4-H continues to be the empowerment of the volunteer in the local community to work with a group of youth in exploring a subject of interest and concern. Objectives are to provide educational experiences to increase the competency, coping skills and contributory skills of the 4-H'er. Once a 4-H'er learns a skill, opportunities are provided for them to pass that on to another. The 4-H audience includes the youngster, his or her family, the volunteer and the local community. 4-H provides the community an opportunity to develop the youth with the aid of their land-grant institution, coordinated by a resident county Extension professional who is a member of the Clemson University staff. The 4-H camping effort in South Carolina was enhanced in 1985 by completion of a new multi-purpose building and major renovations to Camp Bob Cooper near Summerton.

The staffing for 4-H also was analyzed and adjusted to include the appointment of nine individuals as 4-H agents in selected counties. These persons will give primary leadership to 4-H in their respective counties and coordinate the activities of other personnel in cooperation with the county chairman. Two new faculty members were selected for the 4-H department to give leadership to the areas of teen programming and volunteer leadership development.

#### DIVISION OF REGULATORY AND PUBLIC SERVICE PROGRAMS

H.B. Jackson, Acting Director

This division of Clemson University operates several consumer protection-type programs closely related to the agricultural sector. The philosophy for having regulatory programs at Clemson is that certain regulations can be enforced more effectively when strong educational approaches are used. Regulatory and Public Service Division personnel use this technique as a normal procedure. The division maintains close coordination with the Cooperative Extension Service and the S.C. Agricultural Experiment Station and solicits their aid when additional educational and research efforts are needed. Strict enforcement is used only against recalcitrant offenders.

The major objective of this division is to ensure that consumers buying lime, fertilizers, pesticides and seed get the qualities indicated on tags or labels. It enforces regulations of the Crop Pest, Boll Weevil Eradication, Bee Disease and Abandoned Orchards acts and imposes quarantines when needed. The division also was given the responsibility for enforcing the S.C. Pesticide Control Act and the S.C. Agricultural Liming Materials Act of 1976.

A reorganization of the division was effective July 1, 1985, which combined similar duties and changed departmental names. The Plant Pest Regulatory Service, which is responsible for all plant regulatory and quarantine programs, was changed to the Department of Plant Industry. However, all pesticide program responsibilities (registration, quality control, and certification and licensing of applicators) that were previously in the department have been transferred along with personnel to the Department of Fertilizer and Pesticide Control. Following are highlights of division activities for 1985-86.

#### Department of Agricultural Chemical Services

This department performs the chemical analyses reported by the Department of Fertilizer and Pesticide Control. Most samples analyzed were multi-component, with more than 25,000 individual analyses made. The laboratory has concentrated on improved methodology, instrumentation and organization to analyze all samples quickly and accurately. The department performed more than 47,500 analyses for the S.C. Agricultural Experiment Station. In addition, the Agricultural Service Laboratory processed more than 79,150 soil samples, 4,600 plant and feed samples and 5,700 samples for nematodes.

#### Department of Plant Industry

##### The Crop Pest Act

Nursery Inspections: A total of 520 nurseries, greenhouses and vegetable transplant growers and 765 nursery dealers, including eight dealers outside the state, were licensed to sell plant material. An additional 260 establishments were visited on routine inspections to determine compliance with quarantines and regulations to provide assistance with pest problems. Twenty-four other nurseries were not certified on the initial inspection due to pests, weeds or other problems.

Phytosanitary Certification: Nearly 250 phytosanitary certificates (122 state and 126 federal) were issued for various agricultural planting seed, flue-cured tobacco, and plant material, primarily orchids and chrysanthemum cuttings destined to other states, Puerto Rico, Canada and 40 other foreign countries. Sixty-four phytosanitary certificates were issued for shipments of plant material to Canada, and several certificates were issued for shipments to Bermuda, Trinidad, England, Spain, Japan and Saudi Arabia.

Miscellaneous Inspections: Twenty-three regular certificates of plant inspection were issued for assorted houseplants being moved within the United States. Inspections of tobacco plant beds were again made for Pee Dee area growers in connection with North Carol-



ina's import permit requirements. However, only 38 import applications were received from the N.C. Department of Agriculture this year compared to more than 150 in 1985. Severe weather conditions last year created a plant shortage.

Postentry Inspections: Thirteen postentry inspections were conducted for six individuals or establishments who received feijoa plants from New Zealand, roses from England, eucalyptus plants from Brazil and apple seedlings from France.

Sweet Potato Inspections: Seventy-seven inspections were conducted for 23 growers in the Pee Dee, Sandhill and Coastal Plains regions.

Phony Peach: The 1985 survey for phony peach disease was conducted in the Ridge, Sandhill and Coastal Plains areas. Four temporary inspectors were hired. About 1.3 million trees were surveyed with 473 (.04 percent) found diseased. Several cases of rosette also were found.

Bee Disease Act: Of the 1,249 bee colonies inspected, four were infested with disease. A total of 1,428 colonies were certified for movement to other states. More than 475 other beekeeper contacts were made regarding various bee problems. Numerous educational activities were conducted during the year including presentations, news articles and demonstrations.

Twenty-two bee samples were collected from beekeepers throughout the state and analyzed for acarine mite. Results were negative, but the mite was reportedly found in Canada in bees originally shipped from South Carolina.

#### Cooperative State/Federal Programs

The department and USDA renewed the cooperative agreement in 1985 whereby the state would hire seasonal employees. Eighty-seven employees were hired to survey and perform control activities. Most began work in the spring, with additional employees hired during the summer. All were terminated at the end of the federal fiscal year.

Witchweed: Statistics for 1985 show that 10 new farms with 356 acres were infested with witchweed. More than 4,800 actual and about 11,230 aggregate acres were treated. Since the beginning of the witchweed program, 1,779 farms and 46,613 acres have been released from quarantine. Remaining infested farms and acres in South Carolina are 960 and 25,064 respectively. Darlington County was released from quarantine this year, leaving only five counties under quarantine. They are Dillon, Florence, Horry, Marion and Marlboro.

Gypsy Moth: In 1985, 240 adult male moths were trapped as compared to 213 in 1984. Of these, 188 were caught in Horry County. One adult moth was found near McCormick, a first for the county. Egg mass and larval surveys were conducted at several high priority sites with negative results. Fifteen inspections were made of outdoor articles coming in from high risk areas.

Imported Fire Ant: This pest now infests an estimated 14.5 million acres in 42 of the 46 counties. Abbeville and Cherokee are the only two counties in which fire ants have never been reported. Artificial spread via nursery stock and pine straw is responsible for most of the small isolated infestations. Natural spread was the primary

means of expansion during the population explosion this past fall.

Isolated infestations in Pickens, Greenville, Oconee, Anderson and Greenwood counties were treated using individual mound application. Different materials such as Amdro, Pro-Drone, Accudose aerosol injections and Orthene 75 SP were used. The objective was to minimize spread within the county and alleviate additional regulatory problems. A special meeting was held March 12, 1986, at the S.C. Farm Bureau to update key legislators and others on the imported fire ant problem. They were concerned about the recent build-up and the number of complaints from constituents. Extension entomology and the Department of Plant Industry reported on current and past activities, stressing that eradication is not feasible with current materials and technology.

Boll Weevil: USDA program personnel reported excellent progress for the eradication program in 1985. The majority of the fields in the eradication area had no weevils at all or only scattered captures. Through November only about 20 fields showed any consistent evidence of reproduction. Trap captures in the buffer zone were higher than the previous fall due to the massive weevil migration from the south. General treatments were conducted in the buffer zone into December due to the late killing frost.

The 1986 season began the first year of the containment program. Farmer costs are \$15 per acre. In 1986 only 115 weevils had been trapped in the eradication zone. Many fields are weevil free. More than 70,000 weevils have been trapped in the buffer zone. However, specialists predict no economic problems to cotton in these areas.

Citrus Fumigation: USDA, Plant Protection and Quarantine were asked to perform export certification in South Carolina for grapefruit from Florida which was being shipped to Japan. USDA and Plant Industry worked cooperatively on this task, which was beneficial to both Florida and South Carolina growers. More than 1,010 containers with 1,152,144 boxes of fruit valued at more than \$10 million passed through the Yemassee terminal and the port of Charleston. Five people in Yemassee worked year round on the project. This additional work brought more than \$200,000 into this rural community and to South Carolina farmers.

#### National Plant Pest Survey and Detection Program

Japanese Beetle: Trapping was done in Berkeley and Greenwood counties. A large portion of Greenwood County was found infested and placed under quarantine. Berkeley County was reported negative.

Exotic Pest Detection: A total of 340 traps were placed throughout the state. One-fourth were located in apple orchards in Oconee County to determine if the plum fruit moth and summer fruit tortrix moth was there. The rest were put in cotton fields to check for the false codling moth and Egyptian and African cotton leafworms. These exotic pests were not trapped, but closely related native species were caught.

#### Department of Seed Certification

Seed certification is a program of standards imposed on seed and



plant production that ensures varietal purity, good germination and freedom from noxious weed seeds. Participation in the program is voluntary.

Clemson University was designated by law in 1945 as the agency for inaugurating and carrying out a program of certification of pure seed and plants in South Carolina. The Seed Certification Department of Clemson and other seed certification agencies in the United States must comply with standards for certification of seed in Federal Seed Act Regulations.

Departmental field work in 1985-86 involved inspections of 43,386 acres of crops for certified seed production. Inspections included 93 varieties of 16 crops for 345 farmer/growers and 32 seed-producing firms. Each field was inspected to determine that the crop was true to variety and free of noxious weeds and seed-borne diseases.

Major acreages of crops inspected were soybeans, 28,911; small grains, 11,322; cotton, 1,490; and peanuts, 1,108. In addition, other field work involved grow-out plantings of 167 samples of South Carolina certified soybeans and small grains for comparison to producer or processors' samples of the same seed lots. During 1985-86, 385,138 certified seed tags were issued to growers whose seed met standards both in the field and the laboratory. Thirty-seven facilities were inspected and approved during the year for custom processing of South Carolina certified seed.

#### Department of Fertilizer and Pesticide Control

The Department of Fertilizer and Pesticide Control is responsible for enforcing the provisions of a number of laws and regulations. The S.C. Fertilizer Law and the S.C. Agricultural Liming Materials Act are primarily designed to ensure that consumers receive high quality fertilizer and lime.

Some of the major activities of this department relative to these statutes during the period July 1, 1985-June 30, 1986, follow:

Fertilizer usage data, tons sold.....	564,864
No. of fertilizer samples procured and analyzed.....	4,945
No. of fertilizer samples not meeting guarantee.....	855
No. of lime material samples procured and analyzed.....	201
Total number of lime samples not meeting guarantees.....	12
Percent of lime samples deficient.....	6
Total number individual deficiencies in lime samples.....	14
Number of irregularities other than underweight.....	2
Weight irregularities.....	3
Fines collected, payable to state treasurer*.....	\$185.00
Fertilizer penalties collected, paid to state treasurer*..	\$43,100.00
(Deficiencies where consumers not identifiable)	
Lime penalties collected, paid to state treasurer*.....	\$338.00
(Deficiencies where consumers not identifiable)	
Fertilizer registration fees, paid to state treasurer*....	\$8,809.00
Lime registration fees, paid to state treasurer*.....	\$810.00
Lime permit fees, paid to state treasurer*.....	\$1,411.00
Fertilizer taxes turned over to state treasurer*.....	\$141,990.00

\*Actually recorded by state treasurer July 1, 1985-June 30, 1986, but may not correspond to final fees paid for the fiscal year.

## Fertilizer Movement and Quality Control in 1985-86

The fertilizer tonnage sold this year was down significantly from 1984-85. The 564,864 tons sold is the lowest yearly total since 1933. Overall, 17.3 percent of fertilizer samples did not meet the guarantees within the investigational allowances. This deficiency rate was 3 percent lower than in 1984-85. This difference is partially due to an expansion of the allowable tolerances. Other than deficiencies, the greatest problem in the fertilizer and lime areas continues to be the lack of proper labeling.

## South Carolina Pesticide Control Act

This act mandates not only quality control monitoring, but also regulates the sale, use and application of all pesticides used in South Carolina. The department uses a strong preventative education program coupled with fair enforcement actions when necessary to help ensure productivity while preventing adverse effects on man or the environment.

In an effort to improve its education and enforcement capabilities, the department has pursued external sources of funds where possible without decreasing the flexibility of the pesticide program. These efforts have resulted in two grants totaling \$152,033 from the federal Environmental Protection Agency. The department also has made a concerted effort to increase efficiency by using state-of-the art data management.

Registration and Quality Control: In 1985 a total of 704 companies registered 7,322 pesticide products for sale in South Carolina. A total of 1,671 pesticide samples were collected and analyzed with five found deficient in the guaranteed percentage of one or more ingredients. Stop-sale notices were issued on all deficient products. Registration fees totaling \$130,519 were deposited. Using provisions of the Federal Pesticide Control Act, the department issued five Section 24 (C) special local need registrations. No Section 18 emergency exemptions were issued.

Certification: Pesticide dealers and applicators must be certified and licensed to buy, sell or apply pesticides classified for restricted use. Last year 8,633 private applicators licenses, 1,458 commercial applicators licenses, 754 non-commercial licenses and 377 pesticide dealers licenses were issued. Certification fees totaling \$41,913 were collected.

Education and Enforcement: Pesticide personnel made frequent contact with pesticide dealers, Extension chairmen and various applicators and pest control operators. Numerous structural pest inspections were conducted. The promulgation of structural pest control regulations in 1980 and mandatory licensing in 1983 has significantly increased the workload in this area. This is providing a valuable service to both the industry and consumers. Although strong enforcement measures were required in a few instances, most pest control companies are voluntarily correcting violations and refunding charges for unnecessary pest control activities.

Sixty-one civil penalties ranging from \$50 to \$250 (total \$8,900)



were assessed and 6 criminal prosecutions resulted in convictions. Forty-five investigations were conducted on potential pesticide misuse. Numerous stop-sale notices were issued for unregistered products, sale of restricted products by unlicensed dealers and other violations. A hundred warning letters were issued. Overall, compliance with the act by members of the agribusiness industry has been excellent. Administration of the department's regulatory programs resulted in a total of \$378,000 being sent to the state treasurer.

#### LIVESTOCK-POULTRY HEALTH DIVISION C.E. Boyd, Director

The Livestock-Poultry Health Division conducts a number of regulatory programs in consumer protection and animal health and the diagnosis of various disease problems in South Carolina livestock. The division's three main areas of responsibility are the administration of the South Carolina Meat and Poultry Inspection Programs, the Livestock Regulatory Programs and the Diagnostic Laboratory. The Animal and Plant Health Inspection Service, USDA, cooperates with the Livestock-Poultry Health Division in carrying out certain animal disease eradication programs conducted on a national basis. It also provides 50 percent of the funds for administering the South Carolina Meat and Poultry Inspection Program.

Following are highlights of this division during 1984-85:

#### Cooperative Disease Eradication Program

National disease eradication programs have been established in this country to eradicate certain national livestock diseases that cause great economic loss to the livestock industry. Our major programs are aimed at the eradication of brucellosis and tuberculosis in cattle and pseudorabies in swine. During the year, the USDA approved the shipment of 11 mares under quarantine in South Carolina for intensive testing. These horses came from West Germany where contagious equine metritis exists. All were found to be free of the disease and were released from quarantine.

#### Livestock Auction Market Inspection

All livestock going through auction markets are inspected for contagious and infectious diseases. Approximately 100 livestock auction sales are held each month at the 20 livestock markets in South Carolina. This division furnishes a veterinarian and livestock inspector at each sale to ensure compliance with all animal health requirements. In addition, a veterinarian is present at all dispersal and consignment sales for cattle and swine. One permit was issued during the year to operate a new auction market.

## Meat and Poultry Inspection

This department's responsibilities cover the wholesomeness of meat and poultry slaughtered and food products processed at all processing plants in South Carolina except for a small number of plants that operate under federal jurisdiction. There are 113 meat and poultry plants under state inspection. The full-time staff includes six veterinarians, 55 inspectors, a compliance/evaluation officer and two administrative personnel. More than 100 million pounds of red meat and poultry are inspected annually in state plants. The state's programs continue to meet standards that classify it as equal to the federal Meat and Poultry Inspection Program.

## Animal Diagnostic Laboratory

The laboratory is staffed by six veterinarians and 11 technicians. It provides diagnostic services in animal pathology, bacteriology, virology and serology for the regulatory programs as well as diagnostic help to practicing veterinarians and livestock and poultry owners in the state. During the year the laboratory handled more than 3,000 cases and conducted more than 200,000 laboratory tests and examinations.



# CLEMSON UNIVERSITY



## Addendum to ANNUAL REPORT 1985-1986

## Department of Parks, Recreation and Tourism Management

### Teaching

Instructional personnel are dedicated to excellence in education at the bachelor's, master's and doctoral levels. Professional preparation for careers in public and private leisure-service agencies include: county and municipal leisure services; state and county recreation resource management systems; therapeutic recreation settings; and the broad field of travel and tourism management.

Highlights within the department's instructional program for 1985-86 include:

- o Acceptance of a Ph.D. proposal by the S.C. Commission on Higher Education.
- o A continued increase in student credit-hour production; a reflection of an increase in departmental undergraduates and an increase of nonmajors in PRTM courses.
- o Adjustments in courses to incorporate new technologies and ideas within the field.
- o Faculty enhancement to keep pace with the growing student demand for the travel and tourism emphasis area.

### Public Service/Research

Research dollars have been applied to problems in South Carolina, especially economic benefit models from local festivals and developing traveler profiles in South Carolina tourist regions. Faculty continue to actively pursue research that will bring national visibility to Clemson and South Carolina. Data from a recreation survey were obtained and allowed Clemson to secure contracts for analysis of these data. This may lead to recognition as a national recreation data depository and analysis center.

Faculty made presentations at eight national and 14 regional meetings. Sixty publications were generated, with about one-third appearing in national refereed journals. Faculty are continuously requested to serve as referees or special editors of research publications.

The National Parks Service Cooperative Research Unit, administratively housed in this department, has increased involvement of this faculty and was instrumental in attracting a faculty member from Purdue to Clemson for the year. New thrusts and visibility in tourism research are projected through the recently approved Institute for Recreation, Travel and Tourism.

### Public Service/Extension

A growing awareness of the importance of tourism as an economic force was evidenced by the number and nature of Extension-related requests for information and technical assistance during the year. Assistance was given to South Carolina citizens starting new businesses, to 13 state and local government offices, and to 32 private companies and chambers of commerce. Out-of-state requests were mostly met by referral to appropriate agencies or companies in the requestors' own states or provinces.

Fifty-three Extension-related requests were processed during the year, including festival development and impact analysis, planning and development of improved tourist services, community recreation



desires analysis, and general tourism statistics and marketing information. In addition, tourism development studies were accomplished through student projects in the community tourism development course, demonstrating a melding of instruction and service with mutual benefits for all groups concerned.

#### Clemson University Outdoor Laboratory

The programs and services available at the Outdoor Laboratory serve individuals and groups from every county in South Carolina. This is particularly true during the 10-week summer residential camping season when more than 600 children, teenagers and adults with special needs are served through various programs. During the year, six summer camps, more than 150 user groups, and 10,000-plus persons were served by the laboratory staff.

The Outdoor Laboratory also is being used by many Clemson University disciplines for education, research and public service. Support during the year has been received from the South Carolina Jaycees, South Carolina Sertomans, Mid-Day Lions Club of Anderson, Knights of Columbus, South Carolina Council, Department of Youth Services, Hemophilia Foundation of South Carolina and the U.S. Forest Service.

Though not completely independent of state support, the laboratory continues to rely less on state dollars each year while generated income and public service activities continue to increase. Five professional and support staff salaries are included in the annual PRTM budget. All other personnel, food service, maintenance and program expenses are recovered through user groups and camps.

A project to create an endowment for the Clemson University Outdoor Laboratory is currently under way. In 1985, a commitment of \$125,000 over a five-year period was made by the South Carolina Jaycees and Jaycee Women (Project Rainbow for Hope). Camp Sertoma of South Carolina, Inc., will raise during the next two years the needed \$132,000 for a swimming pool at the Outdoor Laboratory (Project SPLASH).

#### Professional Development Programs

The number and diversity of programs and the number of participants have seen continued growth. During the past year, 16 professional development programs have been provided for state and local government, the U.S. Forest Service, the National Park Service, South Carolina swimming pool operators, tourism personnel, outdoor recreation planners and educators. These programs served approximately 900 clients and grossed a total of about \$300,000. Services rendered are at the maximum level until staff can be added specifically for professional development programs.

#### Regional Resources Development Institute

Created in 1981 as the Energy and Resource Development Institute, the Regional Resources Development Institute (RRDI) is a cooperative venture between the Southern Appalachian Research/Resource Management Cooperative (SARRMA) and Clemson University. The Institute's purpose is to stimulate and coordinate research in the areas of natural resource allocation and management, energy conservation, conflict management over natural resource policy uses, regional tourism



assessment and development, and natural resource policy assessment. RRDI's projects involve scientists and graduate students of SARRMC-member organizations and involve site studies throughout the entire Southeastern United States.

During 1985-86 eight agency reports were presented; five public participation research workshops were conducted; two presentations were given at national research symposiums; and six manuscripts were prepared and submitted for publication (four were accepted, two are still in the review process).

RRDI has established a reputation for engaging in applied research related to agency environmental conflict management situations. Current research programs include:

- o Assessing threats to national parks. This program has study sites in South Carolina, Virginia, Pennsylvania and Georgia.

- o Development of a regional resource management program. Results were developed for the Southeast Region, National Park Service and are being implemented nationwide.

- o Tourism and the national parks. This study examines the role of the national parks for stimulating local and regional tourism development.

- o Regional assessment of public perceptions and knowledge of acid deposition problems -- a content and trend analysis.

RRDI is a vehicle for cooperative research. It enhances the College of Forest and Recreation Resources' ability to attract funds from federal land-management agencies and to attract graduate students by providing research opportunities that are both timely and tangible.

In January 1986 RRDI announced an initiative entitled South Carolina Today and Tomorrow, which will be its focus for the next three to five years. The programs of this initiative will examine quality-of-life issues in the context of regional development. The program is based upon citizen input and participation in the economic development of their communities, counties and regions within South Carolina. Through this new program, RRDI plans to serve as a catalyst for faculty and graduate students interested in improving the quality of life, allocation of resources, and citizen participation in regional development in South Carolina and the Southeastern region.

To improve our position for the South Carolina Today and Tomorrow program, RRDI has joined the Southern Growth Policy Board (SGPB) as an associate member. As an initial activity, RRDI cosponsored an upstate Economic Development Conference January 16, 1986, with 10 upstate counties, local cities and towns, and chambers of commerce forming the I-85 Economic Development Workgroup. During the conference a survey was conducted to assess opinion leaders' perceptions of the importance of various issues to local and regional economic development. These data will provide the basis for pursuing additional industrial and state support for the program.

#### Computer Laboratory

The second full year of operation for the college's microcomputer laboratory was successful. Personnel from the National Park Service, U.S. Forest Service, U.S. Army Corps of Engineers, Office of Professional Development in the Department of Management, Continuing Engineering Education, and representatives from private industry used the laboratory to enhance their computer skills, as did



undergraduate and graduate students in the college.

Additionally, the PRM Department sponsored its first youth computer camp attended by nearly 50 youth from four states. It had a gross income of over \$12,000. Actual attendance at the computer camp exceeded 20,000 participant hours with more than \$15,000 in laboratory income in addition to camp fees. This income allowed the purchase of additional computer hardware and software to further enhance the college's ability to incorporate personal computer technology into the management of today's varied and extensive leisure and forest industries.

Courses have been developed within the college devoted to the use of the personal computer as a management tool. Eight college courses regularly use the computer lab.

